# AMENDMENTS

TO

# THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS

FOR

# THE CONTROL OF AGRICULTURAL SUBSURFACE DRAINAGE DISCHARGES

## STAFF REPORT

DRAFT REPORT
MARCH 1996

California Regional Water Quality Control Board
Central Valley Region

Amendments
to
The Water Quality Control Plan
for the Sacramento River and San Joaquin River Basins
for
The Control of Agricultural
Subsurface Drainage Discharges

Staff Report



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California Regional Water Quality Control Board
Central Valley Region
Sacramento, California

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# PART I INTRODUCTION AND BACKGROUND

## Introduction

This report addresses a proposed amendment to the water quality control plan (Basin Plan) for Sacramento River and San Joaquin River Basins. The amendment primarily addresses regulation of agricultural drainage in a portion of the San Joaquin River watershed.

The preparation and adoption of a Basin Plan is required by California Water Code Section 13240 and the Regional Water Quality Control Board, Central Valley Regional (Regional Board) initially adopted a Basin Plan in 1975. A Basin Plan is the basis for regulatory actions that are to be taken for water quality control. The Basin Plan is also used to satisfy Section 303 of the Clean Water Act which requires states to adopt water quality standards to meet federal regulatory requirements. Basin Plans are adopted and amended by the Regional Board using a structured process involving full public participation and state environmental review. A Basin Plan or amendments thereto, do not become effective until approved by the State Water Resources Control Board (State Water Board) and the Office of Administrative Law. A Basin Plan must consist of all of the following (Water Code Section 13050):

a) beneficial uses to be protected;

b) water quality objectives; and

c) a program of implementation needed for achieving water quality objectives.

In 1988, the Regional Board adopted an amendment to the San Joaquin River Water Quality Control Plan for regulation of agricultural subsurface drainage discharges from the Grassland Watershed of Merced and Fresno Counties.

The Regional Board recognized that the 1988 Basin Plan Amendment was a first step in efforts to control agricultural subsurface drainage and that a revision would be needed as new information became available. Developing new information for the revision was to focus on whether the implementation plan was adequate to meet objectives on a continuous basis. The need for this review was based, in part, on testimony received in 1988 that there was not a strong understanding of the relationship between dilution flows and discharge especially in the effluent-dominated water bodies receiving the drainage.

The Regional Board has initiated its effort to review the present San Joaquin River Basin Plan and its implementation plan for regulating agricultural subsurface drainage discharges. The focus of the proposed Basin Plan Amendment is on the control of selenium. This focus is consistent with the Regional Board policy to address toxicants in subsurface drainage as a first priority. Other constituents found in subsurface drainage, such as boron and salt, also impact agricultural beneficial uses. High levels of boron and salt are present in shallow groundwater throughout the west side of the San Joaquin River Basin, whereas, high levels of selenium are limited to a Drainage Problem Area in the Grassland Watershed. The present review of the Basin Plan does not include a review of the water quality objectives or an implementation program for boron and salt, since the sources and beneficial use impacts of these constituents differ significantly from selenium. An amendment which specifically addresses salinity and boron will be prepared at a future date.

Three staff reports on the potential amendment to the Basin Plan were prepared and were the subject of public workshops. This Basin Plan Amendment report is based on the staff reports, comments received at the workshops, and written comments received on the staff reports.

If adopted, the Basin Plan Amendment would result in: 1) new, more stringent selenium water quality objectives in the Grassland watershed wetland supply channels, Salt Slough, Mud Slough (north), and the San Joaquin River; 2) the elimination of subsurface drainage discharges into wetland supply channels, Salt Slough, and Mud Slough (north), unless water quality objectives are being met; 3) the use of waste discharge requirements to control agricultural subsurface drainage discharges to the San Joaquin River below the Merced River confluence; and 4) the prohibition of any new agricultural subsurface drainage discharges from the Grassland watershed unless that discharge is governed by waste discharge requirements.

The purpose of this staff report is to present the Basin Plan Amendment and to provide the rationale behind each part of the amendment. Part I is the introduction and provides historical background for the process. Part II presents the Basin Plan Amendment, which includes beneficial use designations, water quality objectives, and an implementation plan. Part III discusses the rationale for the beneficial uses; part IV discusses the rationale for the water quality objectives; part V discusses the rationale for the program of implementation and includes a discussion of policies, prohibitions, control actions, and the time schedule for compliance. Part V also contains a discussion of a proposed Total Maximum Daily Load (TMDL) submittal to the U.S. Environmental Protection Agency (U.S. EPA) for selenium in the San Joaquin River. This submittal satisfies the requirements of Section 303(d) of the Clean Water Act. Part VI includes the California Environmental Quality Act (CEQA) documentation with supporting material provided in attachmentes. Parts III, IV, and V (beneficial uses, water quality objectives, and the program of implementation) all begin with a brief discussion of the alternatives considered.

This report will be circulated for comment and the proposed Basin Plan Amendment will be the subject of a public hearing before the Regional Board. After the public hearing is closed, the Regional Board may adopt the amendment as proposed or make modifications to the proposed amendment (major modifications would require a new public hearing). The Executive Officer will submit the TMDL to the U.S. EPA for approval upon adoption of the Basin Plan Amendment.

**A public hearing is scheduled for 3 May 1996.** Interested parties are encouraged to comment on the proposed Basin Plan Amendment and staff report. Specific comments on the proposed TMDL are also being solicited at this time. Staff will provide a written response to those comments received by 17 April 1996. To assist staff in identifying and responding to comments, please submit written comments in the format suggested in Appendix 6. The suggested format is to number the comment, state in one sentence the topic of the comment, followed by supporting argument and a specific recommendation. If you have any questions concerning this amendment, please contact Al Vargas at (916) 255-3089.

## Watershed Areas to Be Considered

The amendment being developed is for the Sacramento River and San Joaquin River Basin Plan. The area covered by this Basin Plan includes San Joaquin River and its tributaries. The River flow originates from mountain ranges on both the east and west side of the valley. The mountain ranges on the east (Sierra Nevada) and west side (Diablo Range) of the San Joaquin Valley differ in geology and climate which lead to striking differences in the hydrology and water quality of the streams and soils on the east versus the west side of the San Joaquin Valley. The Sierra Nevada range is composed of granitic material and is subject to a humid environment which accumulates a large snow pack in the winter. The lower elevation Coastal Mountains of the Diablo Range in contrast, are composed of sedimentary materials of marine and continental origin and only receive limited seasonal rainfall, primarily in the winter. Soils on the flood plain and on the alluvial fans east of the San Joaquin River reflect the granitic parent material while those west of the river reflect the sedimentary parent material and differ in mineralogy, chemical and physical properties (USDA, 1952). The result is that streams on the east side that are tributary to the San Joaquin River, are perennial and of good quality (low salinity) while west side streams are ephemeral and of poor water quality due to the marine sediments in the parent material (high salinity and high levels of some trace elements) (Presser et al., 1990).

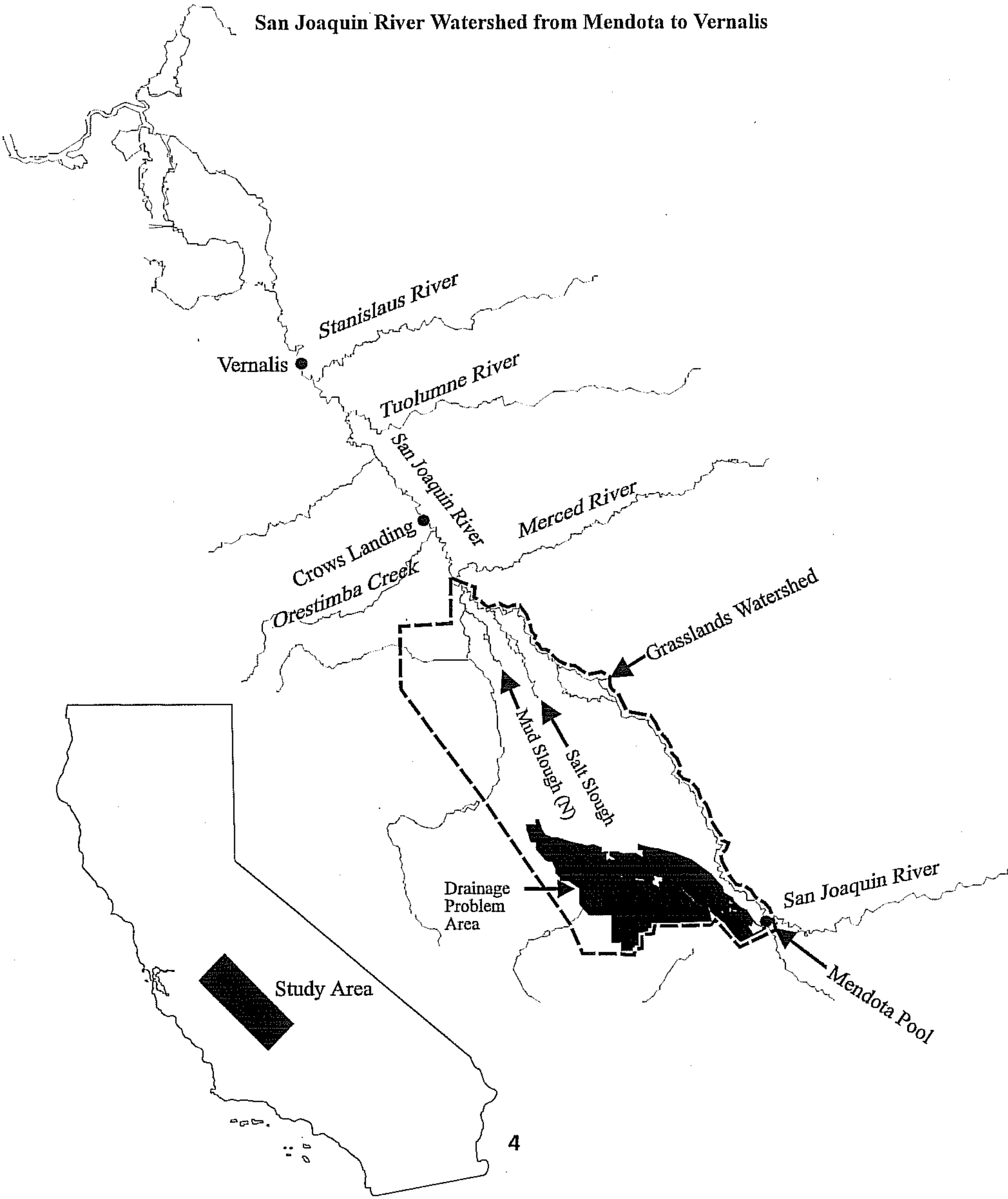
There are two hydrologic areas being considered under this Basin Plan amendment (Figure 1). The first is the Grassland watershed which is a valley floor drainage basin along the western side of the San Joaquin River from the Mendota Pool to the confluence with the Merced River and the second is the main stem of the San Joaquin River downstream of Sack Dam. Differences in geology and hydrology between the two hydrologic units significantly affects water quality and the steps needed to protect beneficial uses.

The Grassland watershed is one of the principal drainage basins within the western portion of the valley floor and is thus influenced by the geologic characteristics described above. The Grassland watershed area considered in this basin plan amendment includes the area east of Interstate 5 and west of the San Joaquin River. The alluvial fan of Orestimba Creek forms the northern boundary and the Tulare Lake Basin forms the southern boundary. This area is composed of approximately 370,000 acres and includes the 90,000 acre Drainage Problem Area as defined in SJVDP, 1990. The principal drainage arteries for the Grassland watershed are Mud Slough (north) and Salt Slough. Both sloughs discharge to the San Joaquin River upstream of the Merced River inflow near the northern boundary of the watershed. These sloughs have undergone dramatic changes in their hydrology and water quality in the past century due to agricultural development and alteration of the San Joaquin River hydrology.

The San Joaquin River downstream of the Merced River inflow, is primarily influenced by flows from the Sierra Nevada Mountains as described above. The tributary inflows in this reach include the Merced, Tuolumne, and Stanislaus Rivers, each of which provides high quality flows. Water quality in this reach of the San Joaquin River is significantly influenced by the quality of discharges from the westside drainage basins such as those coming from the Grassland watershed and the amount of flow available from the eastside tributaries.

**FIGURE 1**

**San Joaquin River Watershed from Mendota to Vernalis**



## Background

In 1983, high frequencies of waterfowl deaths and deformities were observed in Kesterson National Wildlife Refuge (Kesterson Reservoir) and were attributed to toxic concentrations of selenium in agricultural drainage that was entering the site. The source of the agricultural drainage to Kesterson was lands within the Westlands Water District. A survey of lands adjacent to Westlands Water District showed that agricultural subsurface drainage from a large area in the Grasslands watershed also contained high selenium levels. This drainage water was being discharged directly to the Grassland wetlands and the San Joaquin River.

A technical committee was formed (SWRCB Order No. WQ 85-1) to assess this discharge because of its potential impacts on beneficial uses of the San Joaquin River Basin. The technical committee developed a regulatory program including recommended water quality objectives and an implementation plan (SWRCB, 1987). In December 1988, the Regional Board incorporated many of these recommendations into a Basin Plan Amendment for the Regulation of Agricultural Subsurface Drainage. As part of the Basin Plan Amendment, the Regional Board adopted site specific molybdenum, boron, and selenium water quality objectives for the San Joaquin River, Mud Slough (north), and Salt Slough. Selenium objectives were also adopted for wetland water supplies. In setting these objectives, the Regional Board adopted a policy of controlling toxic trace elements, especially selenium, as a first priority.

The water quality objectives varied depending on the location of the water body relative to the Merced River. The reason for the difference was the amount of assimilative capacity available in the water bodies upstream and downstream of the Merced River. The San Joaquin River and its tributary sloughs upstream of the Merced River had less stringent objectives since the flow and quality of these water bodies are governed by agricultural irrigation and wetland return flows (effluent-dominated), while the objectives for the San Joaquin River downstream of the Merced River are more stringent because the natural flow of the San Joaquin River is dominated by the good quality inflows from eastside tributaries. A critically-dry year relaxation for boron and selenium also applied to the San Joaquin River downstream of the Merced River since natural flow from the eastside tributaries drops significantly during droughts.

The focus of the implementation plan adopted in 1988 was on drainage volume and pollutant load reductions through adoption of on-farm best management practices (BMPs)--primarily water conservation. Progress toward meeting water quality objectives was to be documented in annual Drainage Operation Plans (DOPs) which would describe the progress individual water and drainage districts were making toward adoption of BMPs. Waste discharge requirements were to be considered only if water quality objectives were not met by the compliance dates. The Regional Board also adopted a prohibition against activities that would increase the discharge of poor quality agricultural subsurface drainage. The Regional Board recognized that, as more information became available on the beneficial uses of the watershed and effectiveness of the BMPs, the basin plan amendment might have to be reconsidered.

The State Water Board approved the Regional Board Basin Plan Amendment in September 1989 but disapproved the proposed beneficial uses of Mud Slough (north) and Salt Slough. Following State Water Board approval, the U.S. EPA, which has approval authority over state water quality objectives for surface waters, disapproved many of the adopted objectives. Primarily, the selenium objective for the effluent-dominated water bodies upstream of the Merced River (10 µg/L) was disapproved. These water bodies included Mud Slough (north), Salt Slough, and the San Joaquin River upstream of the Merced River. In addition, the critical year selenium objective (8 µg/L) for the San Joaquin River downstream of the Merced River was disapproved.

The U.S. EPA approved the 5 µg/L monthly mean selenium objective in the San Joaquin River downstream of the Merced River. In addition, the U.S. EPA approved the 2 µg/L monthly mean selenium objective for the water delivered to wetland areas within the Grassland watershed.

According to Federal Regulations, a water quality objective adopted by the Regional Board and approved by the State Water Board remains in effect, even though disapproved by U.S. EPA, until the State revises it or U.S. EPA promulgates a rule that supersedes the State water quality objective (40 CFR 131.21 (c)). In December 1992, the U.S. EPA promulgated a 5 µg/L, 4-day average selenium water quality criteria for all of the water bodies (except wetlands) that were covered by the 1988 Regional Board Basin Plan Amendment. This promulgation also superseded the 5 µg/L monthly mean selenium objective originally approved by U.S. EPA for the San Joaquin River downstream of the Merced River. Regional Board counsel has interpreted the U.S. EPA promulgation of a selenium water quality criteria as effectively preempting the water quality objectives adopted by the Regional Board and approved by the State Water Board. Based on this interpretation, the Regional Board, in December 1994, deleted from the Basin Plan all water quality objectives for selenium that were superseded by the U.S. EPA promulgation.

**Need for a Revision to the Basin Plan**

The Regional Board recognized that the 1988 Basin Plan Amendment was a first step in efforts to control agricultural subsurface drainage and that a revision would be needed as new information became available. Developing new information for the revision was to focus on the adequacy of the water quality objectives to protect beneficial uses and whether the implementation plan was adequate to meet objectives on a continuous basis. The need for this review was based on testimony received in 1988 that there was a lack of a strong understanding of the relationship between dilution flows and discharge especially in the effluent-dominated water bodies.

The 1992 promulgation of more stringent water quality criteria by the U.S. EPA again raised a question regarding the adequacy of the previously adopted water quality objectives and the implementation plan outlined in the Basin Plan. The U.S. EPA promulgation of the national water quality criteria, however, did not include an evaluation of the means of compliance or the cost of compliance, both requirements under State law.

Under the 1988 Basin Plan Amendment, the Regional Board emphasized on-farm water conservation measures as the primary method for meeting water quality objectives and reducing pollutant loads. Studies conducted for the Regional Board (CVRWQCB, 1994) show that irrigation efficiency has improved in the Drainage Problem Area. As shown in Figure 2, selenium loads decreased significantly through water year (WY) 1992, but increased in WY 1993 and remained elevated in WY 1994. The increase in load in WYs 1993 and 1994 occurred despite continuing increases in irrigation efficiency.

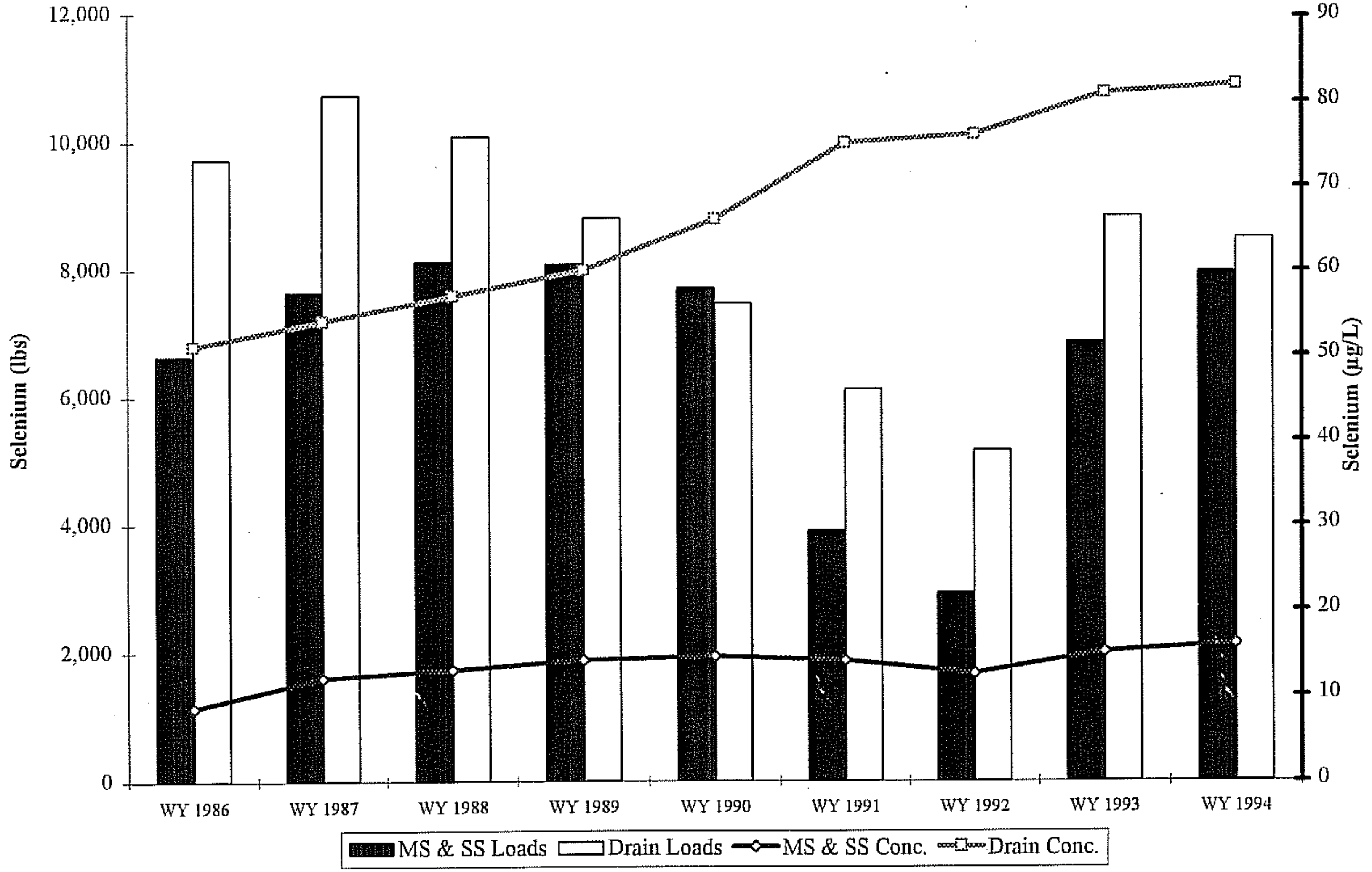
An increase in irrigation efficiency can result in a reduction in high quality surface runoff (tail water) and/or poorer quality deep percolation (tile water). The drought and restrictions in water supply since 1988 prompted adoption of farm water conservation measures to minimize the discharge of the high quality tail water and operational spills. Previously, these better quality flows served to dilute the agricultural subsurface drainage flows. Discharge from the Drainage Problem Area is now dominated by poor quality tile water, thereby raising the concentration of drainage discharges (Figure 2). Although loads decreased significantly by WY 1992, the increases in effluent concentration combined with the lack of dilution flow in the sloughs resulted in little change in water quality in the sloughs.

In contrast, water quality in the San Joaquin River downstream of the Merced River improved dramatically in response to the load reductions. For example, the large selenium load reductions in WY 1992 resulted in only one month when mean selenium concentrations exceeded 8 $\mu$g/L. The results document a significant improvement in water quality even though WY 1992 was the sixth consecutive critically-dry year. The increase in selenium loads to the San Joaquin River in WYs 1993 and 1994 led to increased mean monthly selenium concentrations. For example, in WY 1994, the monthly mean selenium concentration exceeded 8 $\mu$g/L three out of twelve months downstream of the Merced River and exceeded 10 $\mu$g/L in seven out of twelve months upstream of the Merced River.

Failure to meet water quality objectives for selenium and other constituents has led the State of California to list the lower reach of the San Joaquin River as a water quality limited segment as required by the Federal Clean Water Act (Title III, Section 303(d)) and its implementing regulations (40 CFR Ch.1, Subchapter D, Section 130.7). The Regional Board, in November 1991 adopted a Water Quality Assessment that included a description of 130 miles of the San Joaquin River that are impaired and listed that segment in accordance with Section 303(d) of the Clean Water Act. In addition to listing a water body, Federal regulations require the calculation of a "Total Maximum Daily Load" (TMDL) for the listed water body. The TMDL is then apportioned to point sources, non-point sources, and a margin of safety. The TMDL is a load based objective which is designed to attain and maintain the numeric concentration-based water quality objective (see Karkoski, 1994 for a more thorough discussion).

In the 1988 Basin Plan Amendment, the Regional Board identified selenium as the highest priority for action on the lower reach of the San Joaquin River. Under the direction of the State Water Board staff, Regional Board staff have developed a TMDL workplan for the highest priority water bodies in the Region with U.S. EPA approving the development of a TMDL for selenium as the highest priority for the San Joaquin River. This TMDL is proposed as part of the implementation plan for controlling subsurface agricultural drainage.

**Figure 2**
**Annual Selenium Loads and Concentrations for Drains and Sloughs**



**Other Developments Affecting Subsurface Drainage**

In September 1990, one year after the State Water Board approved the Basin Plan Amendment for controlling subsurface drainage, the San Joaquin Valley Drainage Program (SJVDP) completed their recommended Management Plan (SJVDP, 1990a). The plan concentrated on implementation of in-valley management measures through the year 2040. Specific actions were presented on a watershed basis with all of the Drainage Problem Area being within the zone called the Grassland watershed. The State Water Resources Control Board was a signatory to the 1991 Memorandum of Understanding (MOU) with 7 other Federal and State agencies for implementation of the recommended plan. This MOU stated that the Management Plan would be used as a guide for remedying subsurface drainage and related problems. The recommendations of the SJVDP Management Plan for the Grasslands watershed (SJVDP, 1990a) included:

1) Source control for drainage reduction at the farm level;

2) Development of areas for recycling drainage water on more salt tolerant crops;

3) Use of evaporation ponds (120 acres) and solar ponds (130 acres) for final disposal of the unusable drainage water along with mitigation habitat to compensate for any unavoidable losses;

4) Pumping the semiconfined aquifer to control the water table under 10,000 acres of land;

5) Retiring 3,000 acres of irrigated agricultural land;

6) Discharging good quality (low selenium) drainage to the wetlands and poor quality drainage to the San Joaquin River while meeting water quality objectives;

7) Establishing an additional firm water supply of 129,000 acre-ft (total 180,000 acre-ft) for fish and wildlife purposes (mainly water for wetlands); and

8) Establishing an additional water supply of 20,000 acre-ft in the Merced River to prevent straying of salmon into Salt Slough and Mud Slough (north) during the fall migration run.

The basis for the SJVDP recommendations was the need to meet water quality objectives established in the 1988 Regional Board Basin Plan amendment. The SJVDP plan concludes that objectives in the San Joaquin River downstream of the Merced River can be met through the series of actions listed above. In order to meet objectives in the effluent-dominated sloughs and the Grassland wetlands, however, the SJVDP Plan recommended that the poor quality subsurface drainage be conveyed through a bypass to a point on the San Joaquin River downstream of the Merced River. The SJVDP plan specifically identified a portion of the former San Luis Drain as one component of this bypass plan. This is consistent with the Regional Board acknowledgment in the 1988 Basin Plan amendment that the Zahm - Sansoni Plan, a similar proposal, appeared to be consistent with long-term water quality protection needs on the San Joaquin River, tributary sloughs and the adjacent wetlands.

In 1992, the Central Valley Project Improvement Act (CVPIA) was signed into Federal law. CVPIA provided for 180,000 acre-feet of water for wetlands in the Grasslands watershed, one of the implementation steps of the SJVDP Plan (see step # 7 above). This included water for development of the new state and Federal refuge lands as mitigation for Kesterson Reservoir impacts as required under Section E of Regional Board Order #87-149. Unfortunately, many of the channels used to deliver wetland supplies are also used to convey drainage water.

This shared conveyance system has led to restrictions in the timing of water deliveries to certain wetland areas due to the presence of selenium in the drainage water. These restrictions have occurred with the existing 51,000 acre-feet of delivered supply and will be compounded when the new supplies under CVPIA are delivered in the next few years. This shared conveyance system raises the likelihood for violations of the water quality objective for wetland water supplies. Optimal wetland habitat development will not occur and beneficial use impacts will continue if a conveyance system free of high selenium levels is not available.

In addition to restricting wetland water deliveries, the current shared drainage conveyance system is directly impacting the Los Banos Wildlife Management Area (LBWMA). The drainage is conveyed through Mud Slough (south), which provides water for wildlife habitat within the LBWMA. This flow is then diverted to Salt Slough where beneficial use for the San Luis National Wildlife Refuge and the new refuge lands is being directly impacted.

In summary, several developments since the State Water Board approved the existing Basin Plan Amendment in 1989 require a reevaluation of the Regional Board agricultural subsurface drainage policies and regulations:

1) Although water conservation measures have been implemented, selenium loads are at the same level as in 1989;

2) Water quality in Mud Slough (north), Salt Slough, and the San Joaquin River upstream of the Merced River does not improve in response to pollutant load reductions;

3) U.S. EPA promulgated selenium water quality objectives for the San Joaquin River and sloughs are currently being exceeded at the same rate as in 1989;

4) The U.S. EPA promulgation of a national selenium criteria for the sloughs and San Joaquin River necessitates the Regional Board to consider whether an implementation plan can be developed to meet these criteria;

5) Federal law and regulations require the development of a TMDL (load based water quality objectives) for selenium in the San Joaquin River;

6) Completion of the SJVDP Management Plan requires a reassessment of the Regional Board subsurface drainage policies and implementation strategy in the Basin Plan and to evaluate whether the SJVDP conclusions are adequate to meet the new U.S. EPA promulgated water quality objectives;

7) Concern over the need to expand protection of wetland water supplies; and

8) The need to consider agricultural drainage water management on a watershed basis as proposed in the SJVDP Management Plan.

# PART II PROPOSED AMENDMENTS TO THE BASIN PLAN

The proposed Basin Plan amendment consists of additions, deletions, and modifications to several sections of the document. The amendment is based on modifications to the current plan which would be consistent with recommended alternatives for appropriate beneficial uses, water quality objectives and a program of implementation for water bodies contained within the Grasslands watershed.

This section of the staff report presents the language on regulation of agricultural subsurface drainage discharges as it will appear in the Basin Plan. The following sections in the report describe the changes that were made and the rationale behind those changes. The proposed modifications laid out in this section are organized as follows.

<u>Modifications to Basin Description (Basin Plan Chapter I - Introduction)</u>

A description of the Grassland watershed is proposed as an addition to the Basin Description section of the Basin Plan.

<u>Modification to Beneficial Uses (Basin Plan Chapter II - Existing and Potential Beneficial Uses)</u>

The modifications to beneficial uses consist of the identification of beneficial uses for additional surface water bodies - Salt Slough, Mud Slough (north), and wetland water supply channels in the Grassland watershed. These modifications are identified in Table II-1. The wetland water supply channels being considered are described in Appendix 1 of this report and will be incorporated into the Basin Plan as Appendix 40. The rationale for the beneficial use designations is given in Part III of this report.

<u>Modifications to Water Quality Objectives (Basin Plan Chapter III - Water Quality Objectives)</u>

The selenium water quality objectives are modified for the San Joaquin River from Sack Dam to Vernalis, Mud Slough (north), Salt Slough, and the wetland water supply channels in the Grassland watershed. These modifications are shown in Table III-1 and a description of the rationale for the proposed changes is given in Part IV of this report.

<u>Modifications to Program of Implementation (Basin Plan Chapter IV - Implementation)</u>

*Control Action Considerations of the Central Valley Regional Water Board: Policies*

There are eight policies regarding the control of agricultural subsurface drainage. Four of these policies have been modified ("b", "d", "e", and "f") from those already existing in the Basin Plan. Two policies have been proposed for addition ("g" and "h") and none are proposed for deletion. These policies are used as the basis for developing control actions and prohibitions. An explanation and rationale for these policies and changes is given in Part V of this report.

*Regional Water Board Prohibitions*

The prohibitions related to San Joaquin River Subsurface Agricultural Drainage have been expanded. The prohibitions now include the time schedule for compliance for the selenium water quality objective in Salt Slough and the wetland water supply channels in addition to a maximum selenium load caps for discharge into the San Joaquin River. An explanation and rationale for the prohibitions are given in Part V of this report.

*Actions Recommended for Implementation by Other Entities*

The program of implementation contains actions that may be taken to control the discharge of agricultural subsurface drainage. The control actions include: those actions recommended for implementation by the State Water Board (under - *Recommended for Implementation by State Water Board*); actions recommended for implementation by other agencies (under - *Recommended for Implementation by Other Agencies*); and the required actions and time schedule for compliance for selenium water quality objectives in the San Joaquin River and Mud Slough (north) (under - *Actions and Schedule to Achieve Water Quality Objectives*). A detailed discussion of the control actions is presented in Part V of this report.

*Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources*

The cost of achieving water quality objectives and potential funding sources are modified based on information obtained from the San Joaquin Valley Drainage Program Final Report (SJVDP, 1990) and provided by the San Luis Delta Mendota Water Authority (SLDMWA, 1995). Further discussion of the costs and potential funding sources is presented within Part V of this report.

<u>Surveillance and Monitoring (Basin Plan Chapter V)</u>

Modifications to the surveillance and monitoring program to assess the program of implementation are depicted. Activities to be undertaken by the dischargers and Regional Board are described in Part VI of this report.

The proposed changes to the Basin Plan are presented on the following pages. The additions are highlighted (highlighted) and the deletions are marked in strikeout (~~strikeout~~).

NOTE THAT ONLY THOSE PORTIONS OF THE BASIN PLAN WITH CHANGES ARE PROVIDED. ROWS OF ASTERISKS (* * * * *) INDICATE WHERE SECTIONS OF TEXT HAVE NOT BEEN INCLUDED.

## BASIN DESCRIPTION

This Basin Plan covers the entire area included in the Sacramento and San Joaquin River drainage basins (see maps in pocket* and Figure II-1). The basins are bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. They extend some 400 miles from the California - Oregon border southward to the headwaters of the San Joaquin River.

*NOTE: The planning boundary between the San Joaquin River Basin and the Tulare Lake Basin follows the northern boundary of Little Panoche Creek basin, continues eastward along the channel of the San Joaquin River to Millerton Lake in the Sierra Nevada foothills, and then follows along the southern boundary of the San Joaquin River drainage basin.

The Sacramento River and San Joaquin River Basins cover about one fourth of the total area of the State and over 30% of the State's irrigable land. The Sacramento and San Joaquin Rivers furnish roughly 51% of the State's water supply. Surface water from the two drainage basins meet and form the Delta, which ultimately drains to San Francisco Bay. Two major water projects, the Federal Central Valley Project and the State Water Project, deliver water from the Delta to Southern California, the San Joaquin Valley, Tulare Lake Basin, the San Francisco Bay area, as well as within the Delta boundaries.

The Delta is a maze of river channels and diked islands covering roughly 1,150 square miles, including 78 square miles of water area. The legal boundary of the Delta is described in Section 12220 of the Water Code (also see Figure III-1 of this Basin Plan).

Ground water is defined as subsurface water that occurs beneath the ground surface in fully saturated zones within soils and other geologic formations. Where ground water occurs in a saturated geologic unit that contains sufficient permeability and thickness to yield significant quantities of water to wells or springs, it can be defined as an aquifer (USGS, Water Supply Paper 1988, 1972). A ground water basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers (Todd, *Groundwater Hydrology*, 1980).

Major ground water basins underlie both valley floors, and there are scattered smaller basins in the foothill areas and mountain valleys. In many parts of the Region, usable ground waters occur outside of these currently identified basins. There are water-bearing geologic units within ground water basins in the Region that do not meet the definition of an aquifer. Therefore, for basin planning and regulatory purposes, the term "ground water" includes all subsurface waters that occur in fully saturated zones and fractures within soils and other geologic formations, whether or not these waters meet the definition of an aquifer or occur within identified ground water basins.

### Sacramento River Basin

The Sacramento River Basin covers 27,210 square miles and includes the entire area drained by the Sacramento River. For planning purposes, this includes all watersheds tributary to the Sacramento River that are north of the Cosumnes River watershed. It also includes the closed basin of Goose Lake and drainage sub-basins of Cache and Putah Creeks.

The principal streams are the Sacramento River and its larger tributaries: the Pit, Feather, Yuba, Bear, and American Rivers to the east; and Cottonwood, Stony, Cache, and Putah Creeks to the west. Major reservoirs and lakes include Shasta, Oroville, Folsom, Clear Lake, and Lake Berryessa.

DWR Bulletin 118-80 identifies 63 ground water basins in the Sacramento watershed area. The Sacramento Valley floor is divided into 2 ground water basins. Other basins are in the foothills or mountain valleys. There are areas other than those identified in the DWR Bulletin with ground waters that have beneficial uses.

### San Joaquin River Basin

The San Joaquin River Basin covers 15,880 square miles and includes the entire area drained by the San

Joaquin River. It includes all watersheds tributary to the San Joaquin River and the Delta south of the Sacramento River and south of the American River watershed. The southern planning boundary is described in the first paragraph of the previous page.

The principal streams in the basin are the San Joaquin River and its larger tributaries: the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers. Major reservoirs and lakes include Pardee, New Hogan, Millerton, McClure, Don Pedro, and New Melones.

DWR Bulletin 118-80 identifies 39 ground water basins in the San Joaquin watershed area. The San Joaquin Valley floor is divided into 15 separate ground water basins, largely based on political considerations. Other basins are in the foothills or mountain valleys. There are areas other than those identified in the DWR Bulletin with ground waters that have beneficial uses.

## GRASSLAND WATERSHED

The Grassland watershed is a valley floor sub-basin of the San Joaquin River Basin. The portion of the watershed for which agricultural subsurface drainage policies and regulations apply covers an area of approximately 370,000 acres and is bounded on the north by the alluvial fan of Orestimba Creek and by the Tulare Lake Basin to the south. The San Joaquin River forms the eastern boundary and Interstate Highway 5 forms the approximate western boundary. The San Joaquin River forms a wide flood plain in the region of the Grassland watershed.

The hydrology of the watershed has been irreversibly altered due to water projects and is presently governed by land uses. These uses are primarily, managed wetlands and agriculture. The wetlands form important waterfowl habitat for migratory waterfowl using the Pacific Flyway. The alluvial fans of the western and southern portions of the watershed contain salts and selenium which can be mobilized through irrigation practices and can impact beneficial uses of surface waters and wetlands if not properly regulated.

**Note: Only those sections of the Existing and Potential Beneficial Uses Chapter with proposed changes are presented here. A row of asterisks indicates where sections of the Chapter have not been included.**

Beneficial uses are critical to water quality management in California. State law defines beneficial uses of California's waters that may be protected against quality degradation to include (and not be limited to) "...domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Water Code Section 13050(f)). Protection and enhancement of existing and potential beneficial uses are primary goals of water quality planning.

Significant points concerning the concept of beneficial uses are:

1. All water quality problems can be stated in terms of whether there is water of sufficient quantity or quality to protect or enhance beneficial uses.

2. Beneficial uses do not include all of the reasonable uses of water. For example, disposal of wastewaters is not included as a beneficial use. This is not to say that disposal of wastewaters is a prohibited use of waters of the State; it is merely a use which cannot be satisfied to the detriment of beneficial uses. Similarly, the use of water for the dilution of salts is not a beneficial use although it may, in some cases, be a reasonable and desirable use of water.

3. The protection and enhancement of beneficial uses require that certain quality and quantity objectives be met for surface and ground waters.

4. Fish, plants, and other wildlife, as well as humans, use water beneficially.

Beneficial use designation (and water quality objectives, see Chapter III) must be reviewed at least once during each three-year period for the purpose of modification as appropriate (40 CFR 131.20).

* * * * *

Surface Waters

Existing and potential beneficial uses which currently apply to surface waters of the basins are presented in Figure II-1 and Table II-1. The beneficial uses of any specifically identified water body generally apply to its tributary streams. In some cases a beneficial use may not be applicable to the entire body of water. In these cases the Regional Water Board's judgment will be applied.

It should be noted that it is impractical to list every surface water body in the Region. For unidentified water bodies, the beneficial uses will be evaluated on a case-by-case basis.

Water Bodies within the basins that do not have beneficial uses designated in Table II-1 are assigned MUN designations in accordance with the provisions of State Water Board Resolution No. 88-63 which is, by reference, a part of this Basin Plan. These MUN designations in no way affect the presence or absence of other beneficial use designations in these water bodies.

In making any exemptions to the beneficial use designation of MUN, the Regional Board will apply the exceptions listed in Resolution 88-63 (Appendix Item 8).

* * * * *

# SURFACE WATER BODIES AND BENEFICIAL USES

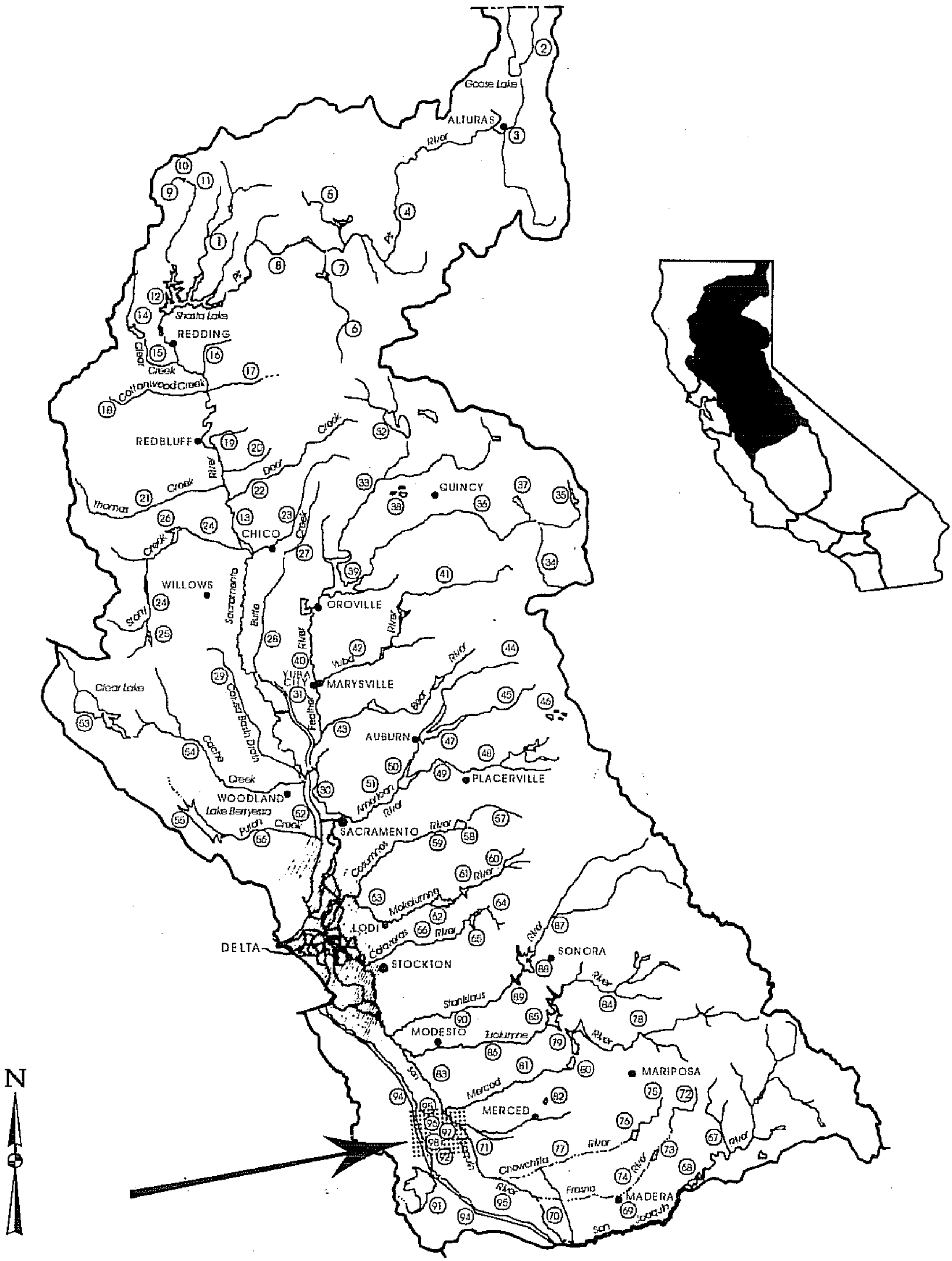


TABLE II-1

# SURFACE WATER BODIES AND BENEFICIAL USES

| | SURFACE WATER BODIES (1) | HYDRO UNIT NUMBER | MUN | AGRI-CULTURE AGR | | INDUSTRY PROC | IND | POW | RECREATION REC-1 | | REC-2 | FRESHWATER HABITAT (2) WARM | COLD | MIGRATION MGR | | SPAWNING SPWN | | WILD | NAV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MUNICIPAL AND DOMESTIC SUPPLY | IRRIGATION | STOCK WATERING | PROCESS | SERVICE SUPPLY | POWER | CONTACT | CANOEING (1) AND RAFTING | OTHER NONCONTACT | WARM | COLD | WARM (3) | COLD (4) | WARM (3) | COLD (4) | WILDLIFE HABITAT | NAVIGATION |
| 1 | McCLOUD RIVER | 505. | E | | | | | E | E | P | E | | E | | | | E | E | |
| 2 | GOOSE LAKE | 527.20 | | E | E | | | | E | | E | E | E | | | | | E | |
| | PIT RIVER | | | | | | | | | | | | | | | | | | |
| 3 | NORTH FORK, SOUTH FORK, PIT RIVER | 526.00 | E | E | E | | | | E | P | E | E | E | | | E | E | E | |
| 4 | CONFLUENCE OF FORKS TO HAT CREEK | 526.35 | E | E | E | | | E | E | E | E | E | E | | | E | | E | |
| 5 | FALL RIVER | 526.41 | E | E | E | | | E | E | E | E | E | E | | | | | E | |
| 6 | HAT CREEK | 526.30 | | E | | | | E | E | | E | E | E | | | | E | E | |
| 7 | BAUM LAKE | 526.34 | | | | | | E | E | | E | | E | | | | P | E | |
| 8 | MOUTH OF HAT CREEK TO SHASTA LAKE | 526. | E | E | E | | | E | E | E | E | P | E | | | E | E | E | |
| | SACRAMENTO RIVER | | | | | | | | | | | | | | | | | | |
| 9 | SOURCE TO BOX CANYON RESERVOIR | 525.22 | | E | E | | | | E | | E | | E | | | | | E | |
| 10 | LAKE SISKIYOU | 525.22 | | | | | | | E | | E | E | E | | | | P | E | |
| 11 | BOX CANYON DAM TO SHASTA LAKE | 525.2 | | E | E | | | | E | E | E | | E | | | | E | E | |
| 12 | SHASTA LAKE | 506.10 | E | E | | | | E | E | | E | E | E | | | E | E | E | |
| 13 | SHASTA DAM TO COLUSA BASIN DRAIN | | E | E | E | | E | E | E | E | E | E | E | E | E | E | E | E | E |
| 14 | WHISKEY TOWN RESERVOIR | 524.61 | E | E | E | | | E | E | | E | E | E | | | E | | E | |
| 15 | CLEAR CREEK BELOW WHISKEYTOWN RESERVOIR | 524.62 | E | E | E | | | | E | E | E | E | E | | E | E | E | E | |
| 16 | COW CREEK | 507.3 | P | E | E | | | E | E | P | E | | E | | E | E | E | E | |
| 17 | BATTLE CREEK | 507.12 | | E | E | | | E | E | E | E | E | E | | E | E | E | E | |
| 18 | COTTONWOOD CREEK | 524.3 | E | E | E | P | P | P | E | E | E | E | E | | E | E | E | E | |
| 19 | ANTELOPE CREEK | 509.63 | E | E | E | | | | E | | E | E | E | | E | E | E | E | |
| 20 | MILL CREEK | 509.42 | E | E | E | | | | E | | E | E | E | | E | E | E | E | |
| 21 | THOMES CREEK | 523.10 | | E | E | | | P | E | | E | E | E | | E | E | E | E | |
| 22 | DEER CREEK | 509.20 | E | E | E | | | | E | E | E | E | E | | E | E | E | E | |
| 23 | BIG CHICO CREEK | 509.14 | | E | E | | | | E | E | E | E | E | | E | E | E | E | |
| 24 | STONY CREEK | 522.00 | | E | E | | | | E | E | E | E | P | | E | E | E | E | |
| 25 | EAST PARK RESERVOIR | 522.33 | | | | | | | E | | E | E | P | | | E | | E | |
| 26 | BLACK BUTTE RESERVOIR | 522.12 | | E | E | | | | E | | E | E | | | | E | | E | |
| | BUTTE CREEK | | | | | | | | | | | | | | | | | | |
| 27 | SOURCES TO CHICO | 521.30 | E | E | E | | | E | E | | | E | E | | E | E | E | E | |
| 28 | BELOW CHICO, INCLUDING BUTTE SLOUGH | 520.40 | | E | E | | | | E | E | | E | E | | E | E | | E | |
| 29 | COLUSA BASIN DRAIN | 520.21 | | E | E | | | | E | E | | E | P | E | | E | | E | |

LEGEND
E = EXISTING BENEFICIAL USES
P = POTENTIAL BENEFICIAL USES
L = LIMITED BENEFICIAL USE

NOTE:
Surface waters with the beneficial uses of Groundwater Recharge (GWR), Freshwater Replenishment (FRSH), and Preservation of Rare and Endangered Species (RARE) have not been identified in this plan. Surface waters of the Sacramento and San Joaquin River Basins falling within these beneficial use categories will be identified in the future as part of the continuous planning process to be conducted by the State Water Resources Control Board.

* * * * *

## SURFACE WATER BODIES AND BENEFICIAL USES

| | SURFACE WATER BODIES (1) | HYDRO UNIT NUMBER | MUN | AGRICULTURE AGR | | INDUSTRY PROC | IND | POW | RECREATION REC-1 | | REC-2 | FRESHWATER HABITAT (2) WARM | COLD | MIGRATION MGR | | SPAWNING SPWN | | WILD | NAV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MUNICIPAL AND DOMESTIC SUPPLY | IRRIGATION | STOCK WATERING | PROCESS | SERVICE SUPPLY | POWER | CONTACT | CANOEING AND RAFTING (1) | OTHER NONCONTACT | WARM | COLD | WARM (3) | COLD (4) | WARM (3) | COLD (4) | WILDLIFE HABITAT | NAVIGATION |
| | MERCED RIVER | | | | | | | | | | | | | | | | | | |
| 78 | SOURCE TO McCLURE LAKE | 537. | P | E | | | | E | E | E | E | E | E | | | | | E | |
| 79 | McCLURE LAKE | 537.22 | P | E | | | | E | E | | E | E | E | | | | | E | |
| 80 | McSWAIN RESERVOIR | 537.1 | P | E | | | | E | E | | E | E | E | | | | | E | |
| 81 | McSWAIN RESERVOIR TO SAN JOAQUIN RIVER | 535. | E | | E | E | E | E | E | E | E | E | E | E | E | E | E | E | |
| 82 | YOSEMITE LAKE | 535.9 | | | | | | | E | | E | E | E | | | | | E | |
| 83 | MOUTH OF MERCED RIVER TO VERNALIS | 535/541 | P | E | E | E | | | E | E | E | E | | E | E | E | | E | |
| | TUOLUMNE RIVER | | | | | | | | | | | | | | | | | | |
| 84 | SOURCE TO [NEW] DON PEDRO RESERVOIR | 536. | E | E | E | | | E | E | E | E | E | E | | | | | E | |
| 85 | NEW DON PEDRO RESERVOIR | 536.32 | P | | | | | E | E | | E | E | E | | | | | E | |
| 86 | NEW DON PEDRO DAM TO SAN JOAQUIN RIVER | 535. | P | E | E | | | | E | E | E | E | E | | E | E | E | E | |
| | STANISLAUS RIVER | | | | | | | | | | | | | | | | | | |
| 87 | SOURCE TO NEW MELONES RESERVOIR (PROPOSED) | 534. | E | E | E | | | E | E | E | E | E | E | | | | | E | |
| 88 | NEW MELONES RESERVOIR | 534.21 | E | E | E | | | E | E | | E | | E | | | | | E | |
| 89 | TULLOCH RESERVOIR | 534.22 | P | E | E | | | E | E | | E | E | | | | | | E | |
| 90 | GOODWIN DAM TO SAN JOAQUIN RIVER | 535. | P | E | E | E | E | E | E | E | E | E | E | | E | E | E | E | |
| 91 | SAN LUIS RESERVOIR | 542.32 | E | E | E | | E | E | E | | E | E | | | | | | E | |
| 92 | O'NEILL RESERVOIR | 541.2 | E | E | E | | | | E | | E | E | | | | | | | |
| 93 | OTHER LAKES AND RESERVOIRS IN SAN JOAQUIN R. BASIN, (EXCLUDING HYDRO UNIT NOS. 531-533, 543, 544) (6) | | E | | | | | E | E | | E | E | E | | | | E | E | |
| 94 | CALIFORNIA AQUEDUCT | 541. | E | E | E | E | E | E | E | | E | | | | | | | E | |
| 95 | DELTA-MENDOTA CANAL | 541/543 | E | E | E | | | | E | | E | E | | | | | | E | |
| | GRASSLAND WATERSHED [a] | | | | | | | | | | | | | | | | | | |
| 96 | MUD SLOUGH (NORTH) | | | L[b] | E | | | | E | | E | E | | | | E | | E | |
| 97 | SALT SLOUGH | | | E | E | | | | E | | E | E | | | | E | | E | |
| 98 | WETLAND WATER SUPPLY CHANNELS (10) | | | L[b] | E | | | | | | | L[c] | | | | | | E | |
| Δ | SACRAMENTO SAN JOAQUIN DELTA (8, 9) | 544. | E | E | E | E | E | | E | E | E | E | E | E | E | E | | E | E |

(1) Shown for streams and rivers only with the implication that certain flows are required for this beneficial use.

(2) Resident does not include anadromous. Any Segments with both COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.

(3) Striped bass, sturgeon, and shad.

(4) Salmon and steelhead

(5) As a primary beneficial use.

(6) The indicated beneficial uses are to be protected for all waters except in specific cases where evidence indicates the appropriateness of additional or alternative beneficial use designations.

(7) Sport fishing is the only recreation activity permitted.

(8) Beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis.

(9) Per State Board Resolution No. 90-28, Marsh Creek and Marsh Creek Reservoir in Contra Costa County are assigned the following beneficial uses: REC1 and REC2

(10) Wetland water supply channels for which beneficial uses are designated are defined in Appendix 40.

[a] The following beneficial uses EXIST in addition to those noted in Table II-1:

Mud Slough (north): COMM and SHELL
Salt Slough: COMM, BIOL, and SHELL
Wetland Water Supply Channels: BIOL

[b] Elevated natural salt and boron concentrations may limit this use to irrigation of salt and boron tolerant crops. Intermittent low flow conditions may also limit this use.

[c] Wetland channels can sustain aquatic life, but due to fluctuating flow regimes and habitat limitations, may not be suitable for rearing and/or propagation.

**Note: Only those sections of the Water Quality Objectives Chapter with proposed changes are presented here. A row of asterisks indicates where sections of the Chapter have not been included.**

The Porter-Cologne Water Quality Control Act defines water quality objectives as "...the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area" [Water Code Section 13050(h)]. It also requires the Regional Water Board to establish water quality objectives, while acknowledging that it is possible for water quality to be changed to some degree without unreasonably affecting beneficial uses. In establishing water quality objectives, the Regional Water Board must consider, among other things, the following factors:

- Past, present, and probable future beneficial uses;
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region;
- The need to develop and use recycled water. (Water Code Section 13241)

The Federal Clean Water Act requires a state to submit for approval of the Administrator of the U.S. Environmental Protection Agency *(USEPA)* all new or revised water quality standards which are established for surface and ocean waters. As noted earlier, California water quality standards consist of both beneficial uses (identified in Chapter II) and the water quality objectives based on those uses.

There are **seven important points** that apply to water quality objectives.

The **first point** is that water quality objectives can be revised through the basin plan amendment process. Objectives may apply region-wide or be specific to individual water bodies or parts of water bodies. Site-specific objectives may be developed whenever the Regional Water Board believes they are appropriate. As indicated previously, federal regulations call for each state to review its water quality standards at least every three years. These Triennial Reviews provide one opportunity to evaluate changing water quality objectives, because they begin with an identification of potential and actual water quality problems, i.e., beneficial use impairments. Since impairments may be associated with water quality objectives being exceeded, the Regional Water Board uses the results of the Triennial Review to implement actions to assess, remedy, monitor, or otherwise address the impairments, as appropriate, in order to achieve objectives and protect beneficial uses. If a problem is found to occur because, for example, a water quality objective is too weak to protect beneficial uses, the Basin Plan should be amended to make the objective more stringent. (Better enforcement of the water quality objectives or adoption of certain policies or redirection of staff and resources may also be proper responses to water quality problems. See the Implementation chapter for further discussion.)

Changes to the objectives can also occur because of new scientific information on the effects of water contaminants. A major source of information is the USEPA which develops data on the effects of chemical and other constituent concentrations on particular aquatic species and human health. Other information sources for data on protection of beneficial uses include the National Academy of Science which has published data on bioaccumulation and the Federal Food and Drug Administration which has issued criteria for unacceptable levels of chemicals in fish and shellfish used for human consumption. The Regional Water Board may make use of those and other state or federal agency information sources in assessing the need for new water quality objectives.

The **second point** is that achievement of the objectives depends on applying them to controllable water quality factors. *Controllable water quality factors* are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Water Board or the Regional Water Board, and that may be reasonably controlled. Controllable factors are not allowed to cause further degradation of water quality in instances where uncontrollable factors have already resulted in water quality objectives being exceeded. The Regional Water Board recognizes that man made changes that alter flow regimes can affect water quality and impact beneficial uses.

The **third point** is that objectives are to be achieved primarily through the adoption of waste discharge requirements (including permits) and cleanup and abatement orders. When adopting requirements and ordering actions, the Regional Water Board considers the potential impact on beneficial uses within the area of influence of the discharge, the existing quality of receiving waters, and the appropriate water quality objectives. It can then make a finding as to the beneficial uses to be protected within the area of influence of the discharge and establish waste discharge requirements to protect those uses and to meet water quality objectives. The objectives contained in this plan, and any State or Federally promulgated objectives applicable to the basins covered by the plan, are intended to govern the levels of constituents and characteristics in the main water mass unless otherwise designated. They may not apply at or in the immediate vicinity of effluent discharges, but at the edge of the *mixing zone* if areas of dilution or criteria for diffusion or dispersion are defined in the waste discharge specifications.

The **fourth point** is that the Regional Water Board recognizes that immediate compliance with water quality objectives adopted by the Regional Water Board or the State Water Board, or with water quality criteria adopted by the USEPA, may not be feasible in all circumstances. Where the Regional Water Board determines it is infeasible for a discharger to comply immediately with such objectives or criteria, compliance shall be achieved in the shortest practicable period of time (determined by the Regional Water Board), not to exceed ten years after the adoption of applicable objectives or criteria. This policy shall apply to water quality objectives and water quality criteria adopted after the effective date of this amendment to the Basin Plan [25 September 1995].

The **fifth point** is that in cases where water quality objectives are formulated to preserve historic conditions, there may be insufficient data to determine completely the temporal and hydrologic variability representative of historic water quality. When violations of such objectives occur, the Regional Water Board judges the reasonableness of achieving those objectives through regulation of the controllable factors in the areas of concern.

The **sixth point** is that the State Water Board adopts policies and plans for water quality control which can specify water quality objectives or affect their implementation. Chief among the State Water Board's policies for water quality control is State Water Board Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California). It requires that wherever the existing quality of surface or ground waters is better than the objectives established for those waters in a basin plan, the existing quality will be maintained unless as otherwise provided by Resolution No. 68-16 or any revisions thereto. This policy and others establish general objectives. The State Water Board's water quality control plans applicable to the Sacramento and San Joaquin River Basins are the Thermal Plan and Water Quality Control Plan for Salinity. The Thermal Plan and its water quality objectives are in the Appendix. The Water Quality Control Plan for Salinity water quality objectives are listed as Table III-5. The State Water Board's plans and policies that the Basin Plan must conform to are addressed in Chapter IV, Implementation.

The **seventh point** is that water quality objectives may be in numerical or narrative form. The enumerated milligram-per-liter (mg/l) limit for copper is an example of a numerical objective; the objective for color is an example of a narrative form.

Information on the application of water quality objectives is contained in the section, *Policy for Application of Water Quality Objectives*, in Chapter IV.

## WATER QUALITY OBJECTIVES FOR INLAND SURFACE WATERS

The objectives below are presented by categories which, like the Beneficial Uses of Chapter II, were standardized for uniformity among the Regional Water Boards. The water quality objectives apply to all surface waters in the Sacramento and San Joaquin River Basins, including the Delta, or as noted. *(The legal boundary of the Delta is contained in Section 12220 of the Water Code and identified in Figure III-1.)* The numbers in parentheses following specific water bodies are keyed to Figure II-1.

* * * * *

## Chemical Constituents

Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The chemical constituent objectives in Table III-1 apply to the water bodies specified. Metal objectives in the table are dissolved concentrations. Selenium, molybdenum, and boron objectives are total concentrations. Water quality objectives are also contained in the Water Quality Control Plan for Salinity, adopted by the State Water Board in May 1991.

At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain lead in excess of 0.015 mg/l. The Regional Water Board acknowledges that specific treatment requirements are imposed by state and federal drinking water regulations on the consumption of surface waters under specific circumstances. To protect all beneficial uses the Regional Water Board may apply limits more stringent than MCLs.

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TABLE III-1
TRACE ELEMENT WATER QUALITY OBJECTIVES

| CONSTITUENT | MAXIMUM CONCENTRATION [a] (mg/l) | APPLICABLE WATER BODIES |
|---|---|---|
| Arsenic | 0.01 | Sacramento River from Keswick Dam to the I Street Bridge at City of Sacramento (13, 30); American River from Folsom Dam to the Sacramento River (51); Folsom Lake (50); and the Sacramento-San Joaquin Delta. |
| Barium | 0.1 | As noted above for Arsenic. |
| Boron | 2.0 (15 March through 15 September)<br>0.8 (monthly mean, 15 March through 15 September) | San Joaquin River, mouth of the Merced River to Vernalis |
| | 2.6 (16 September through 14 March)<br>1.0 (monthly mean, 16 September through 14 March) | |
| | 1.3 (monthly mean, critical year[b]) | |
| | 5.8 [c]<br>2.0 (monthly mean, 15 March through 15 September) [c] | Salt Slough, Mud Slough (north), San Joaquin River from Sack Dam to the mouth of Merced River |
| Cadmium | 0.00022 [d] | Sacramento River and its tributaries above State Hwy 32 bridge at Hamilton City. |
| Copper | 0.0056 [d] | As noted above for Cadmium. |
| | 0.01 [e] | As noted above for Arsenic. [e] |

TABLE III-1 TRACE ELEMENT
WATER QUALITY OBJECTIVES
(Continued)

| CONSTITUENT | MAXIMUM CONCENTRATION[a] (mg/l) | APPLICABLE WATER BODIES |
|---|---|---|
| Cyanide | 0.01 | As noted above for Arsenic. |
| Iron | 0.3 | As noted above for Arsenic. |
| Manganese | 0.05 | As noted above for Arsenic. |
| Molybdenum | 0.015<br>0.010 (monthly mean) | San Joaquin River, mouth of the Merced River to Vernalis |
| | 0.050 [c]<br>0.019 (monthly mean) [c] | Salt Slough, Mud Slough (north), San Joaquin River from Sack Dam to the mouth of Merced River |
| Selenium | 0.012<br>0.005 (4-day average) [f] | San Joaquin River, mouth of the Merced River to Vernalis |
| | 0.020 [f]<br>0.005 (4-day average) [f] | ~~Salt Slough,~~ Mud Slough (north), and the San Joaquin River from Sack Dam to the mouth of Merced River |
| | 0.020<br>0.002 (monthly mean) | ~~Any water supplies used for waterfowl habitat in the Grassland Water District, San Luis National Wildlife Refuge, and Los Banos State Wildlife Area.~~<br>Salt Slough and constructed and re-constructed water supply channels in the Grassland watershed listed in Appendix 40 ~~designated for wildlife (WILD) beneficial use.~~ |
| Silver | 0.01 | As noted above for Arsenic. |
| Zinc | 0.1 [e] | As noted above for Arsenic. [e] |
| | 0.016 [d] | As noted above for Cadmium. |

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a Metal objectives in this table are dissolved concentrations. Selenium, molybdenum, and boron objectives are total concentrations.

b See Table IV-3.

c ~~An alternate set of objectives is proposed to go into effect if the plan to use the San Luis Drain is implemented. The alternate set of objectives provide for better water quality in Salt Slough and the San Joaquin River, Sack Dam to the mouth of Mud Slough (north) and a longer compliance period for Mud Slough (north) and the San Joaquin River, mouth of Mud Slough (north) to mouth of the Merced River.~~ No footnote applies

d The effects of these concentrations were measured by exposing test organisms to dissolved aqueous solutions of 40 mg/l hardness that had been filtered through a 0.45 micron membrane filter. Where deviations from 40 mg/l of water hardness occur, the objectives, in mg/l, shall be determined using the following formulas:

$$Cu = e^{(0.905)(\ln hardness) - 1.612} \times 10^{-3}$$

$$Zn = e^{(0.830)(\ln hardness) - 0.289} \times 10^{-3}$$

$$Cd = e^{(1.160)(\ln hardness) - 5.777} \times 10^{-3}$$

e Does not apply to Sacramento River above State Hwy. 32 bridge at Hamilton City. See relevant objectives (*) above.

f ~~The Regional Water Board has not adopted these selenium concentrations. These selenium concentrations were promulgated by USEPA on 22 December 1992 after USEPA disapproved the Regional Water Board's selenium concentrations. (See 57 Fed.Reg. 60848, 60920.) The selenium concentrations promulgated by USEPA are currently in effect, and are provided in this table solely for reference.~~ No footnote applies

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**Note: Only those sections of the Implementation Chapter with proposed changes are presented below. A row of asterisks indicates where sections of the Chapter have not been included.**

The Porter-Cologne Water Quality Control Act states that basin plans consist of beneficial uses, water quality objectives and a program of implementation for achieving their water quality objectives [Water Code Section 13050(j)]. The implementation program shall include, but not be limited to:

1. A description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private;

2. A time schedule for the actions to be taken; and,

3. A description of surveillance to be undertaken to determine compliance with the objectives (Water Code Section 13242).

In addition, State law requires that basin plans indicate estimates of the total cost and identify potential sources of funding of any agricultural water quality control program prior to its implementation. (Water Code Section 13141). This chapter of the Basin Plan responds to all but the surveillance requirement. That is described in Chapter V.

This chapter is organized as follows: The first section contains a general description of water quality concerns. These are organized by discharger type (e.g., agriculture, silviculture, mines, etc.). The second section lists programs, plans and policies which should result in the achievement of most of the water quality objectives in this plan. This section includes descriptions of State Water Board policies, statewide plans, statewide programs dealing with specific waste discharge problems (e.g., underground tanks, storm water, solid waste disposal sites, etc.), memoranda of understanding, management agency agreements, memoranda of agreement, Regional Water Board policies, a listing of Regional Water Board prohibition areas, and Regional Water Board guidelines addressing specific water quality problems. The third section contains recommendations for appropriate action by entities other than the Regional Water Board. The fourth section describes how; within the framework of the programs, plans and policies discussed in the second section; the Regional Water Board integrates water quality control activities into a continuing planning process. The fifth section identifies the current actions and the time schedule for future actions of the Regional Water Board to achieve compliance with water quality objectives where the programs, plans and policies in the second section are not adequate. The last section lists the estimated costs and funding sources for agricultural water quality control programs that are implemented by the Regional Water Board.

*  *  *  *  *

## Control Action Considerations of the Central Valley Regional Water Board

**Policies and Plans**

The following policies were adopted, or are hereby adopted, by the Regional Water Board. The first four policies listed were adopted as part of the 1975 Basin Plan. Items 7 through 11 are new policies:

*  *  *  *  *

6. *Regional Water Board Resolution No. , San Joaquin River Agricultural Subsurface Drainage Policy*

    a. The control of toxic trace elements in agriculture subsurface drainage, especially selenium, is the first priority.

    b ~~d.~~ Activities that increase the discharge of poor quality agricultural subsurface drainage ~~are prohibited~~ will be discouraged through the adoption of prohibitions of discharge and other control measures.

c ~~e.~~ The control of agricultural subsurface drainage will be pursued on a regional basis.

d ~~f.~~ The reuse of agricultural subsurface drainage will be encouraged, and actions that would limit or prohibit ~~it~~ reuse discouraged.

e ~~b.~~ ~~Of the two major options for disposal of salts produced by agricultural irrigation,~~ ~~e~~Export out of the basin of accumulated salts due to agricultural irrigation and wetlands management ~~has less potential for environmental impacts and, therefore,~~ is the favored disposal option. The San Joaquin River may continue to be used to remove these salts from the basin so long as water quality objectives are met.

f ~~c.~~ ~~The~~ A valley-wide drain to carry ~~the~~ salt ~~generated by agricultural irrigation~~ out of the valley remains the best technical solution to the water quality problems of the San Joaquin River and Tulare Lake Basins. The drain would carry wastewater high in salt and unfit for reuse that is generated by municipal, industrial, agricultural and wetland management activities.

The Regional Water Board, at this time, feels that a valley-wide drain will be the only feasible, long-range solution for achieving a salt balance in the Central Valley. The Regional Water Board favors the construction of a valley-wide drain under the following conditions:

- All toxicants would be reduced to a level which would not harm beneficial uses of receiving waters.
- The discharge would be governed by specific discharge and receiving water limits in an NPDES permit.
- Long-term, continuous biological monitoring would be required.

g. Optimizing protection of beneficial uses on a watershed basis will guide the development of actions to regulate agricultural subsurface drainage discharges.

h. For regulation of selenium discharges, actions need to be focused on selenium load reductions.

* * * * *

**Regional Water Board Prohibitions**

The Porter-Cologne Water Quality Control Act allows the Regional Water Board to prohibit certain discharges (Water Code Section 13243). Prohibitions may be revised, rescinded, or adopted as necessary. The prohibitions applicable to the Sacramento and San Joaquin River Basins are identified and described below. [NOTE: Costs incurred by any unit of local government for a new program or increased level of service for compliance with discharge prohibitions in the Basin Plan do not require reimbursement by the State per Section 2231 of the Revenue and Taxation Code, because the Basin Plan implements a mandate previously enacted by statute, Chapter 482, Statutes of 1969.]

* * * * *

6. *San Joaquin River Subsurface Agricultural Drainage*

~~Activities that increase the discharge of poor quality agricultural subsurface drainage are prohibited. (This is part of the San Joaquin River Agricultural Subsurface Drainage Policy discussed on page IV-17.)~~

a. The discharge of agricultural subsurface drainage from the Grassland watershed to the San Joaquin River or its tributaries from any on-farm subsurface drain, open drain, or similar drain system is prohibited, unless such discharge began prior to (the effective date of this amendment) or unless such discharge is governed by waste discharge requirements.

b. The discharge of agricultural subsurface drainage water to Salt Slough and wetland water supply channels identified in Appendix 40 is prohibited after 1 October 1996, unless water quality objectives are being met. This prohibition may be reconsidered if public or private interests prevent the implementation of a separate conveyance facility for agricultural subsurface drainage.

c. The discharge of agricultural subsurface drainage water to Mud Slough (north) and the San Joaquin River from Sack Dam to the mouth of the Merced River is prohibited after 1 October 2010, unless water quality objectives are being met. This prohibition may be reconsidered if public or private interests prevent the implementation of a separate conveyance facility for agricultural subsurface drainage to the San Joaquin River.

d. The discharge of selenium from agricultural subsurface drainage systems in the Grassland watershed is prohibited in amounts exceeding 8,000 lbs/year for all water year types beginning 1 October 1996.

* * * * *

# ACTIONS RECOMMENDED FOR IMPLEMENTATION BY OTHER ENTITIES

Consistent with the Porter-Cologne Water Quality Control Act, the Basin Plan may identify control actions recommended for implementation by agencies other than the Regional Water Board [Water Code Section 13242(a)].

## Recommended for Implementation by the State Water Board

* * * * *

**Subsurface Agricultural Drainage**

1. ~~As a last resort and where the withholding of irrigation water is the only means of achieving significant improvements in water quality,~~ Tthe Regional Board will ~~consider~~ requesting ~~that~~ the State Water Board use its water rights authority to preclude the supplying of water to specific lands, if water quality objectives are not met by the specified compliance dates and Regional Board administrative remedies fail to achieve compliance.

~~2. The State Water Board should require all water agencies in the San Joaquin Basin, regardless of size, to submit an "informational" report on water conservation.~~

2~~3.~~ The State Water Board should work jointly with the Regional Board in securing compliance with the 2 $\mu$g/l selenium objective for managed-wetlands in the Grassland area.

~~4. The State Water Board give first priority to the use of the Water Conservation and Water Quality Bond Law of 1986 funds for subsurface drainage pollutant control projects in the San Joaquin Basin, especially in those areas that contribute selenium to the San Joaquin River.~~

3 ~~5.~~ The State Water Board should also consider ~~utilizing State Assistance Program~~ gGrant funds to implement a cost share program to install a number of flow monitoring stations within the Grassland area to assist in better defining the movement of pollutants through the area.

4 ~~6.~~ The State Water Board should continue to consider the Drainage Problem Area in the San Joaquin Basin and the upper Panoche watershed (in the Tulare Basin) as priority nonpoint source problems in order to make USEPA nonpoint source control funding available to the area.

5. The State Water Board should seek funding for research and demonstration of advanced technology that will be needed to achieve final selenium loads necessary to meet selenium water quality objectives.

* * * * *

**Agricultural Drainage Facilities**

Facilities should be constructed to convey agricultural drain water from the San Joaquin and Tulare Basins. It is the policy of the Regional Water Board to encourage construction. The discharge must comply with water quality objectives of the receiving water body.

**Subsurface Agricultural Drainage**

1. The entire drainage issue is being handled as a watershed management issue. The entities in the Drainage Problem Area and entities within the remainder of the Grassland watershed need to establish a regional entity with authority and responsibility for drain water management.

2 The regional drainage entity and agricultural water districts should consider adopting economic incentive programs as a component of their plans to reduce pollutant loads. Economic incentives can be an effective institutional means of promoting on-farm changes in drainage and water management.

3~~1.~~ If fragmentation of the parties that generate, handle and discharge agricultural subsurface drainage jeopardizes the achievement of water quality objectives, the Regional Board will consider petitioning the Legislature for the formation of a regional drainage district.

4~~2.~~ The Legislature should consider putting additional bond issues before the voters to provide low interest loans for agricultural water conservation and water quality projects and incorporating provisions that would allow recipients to be private landowners, and that would allow irrigation efficiency improvement projects that reduce drainage discharges to be eligible for both water conservation funds and water quality facilities funds.

5~~3.~~ The San Joaquin Valley Drainage Implementation Program should continue to investigate the alternative of a ~~local~~ San Joaquin River Basin drain to move the existing discharge point for poor quality agricultural subsurface drainage to a location where its impact on water quality is less. ~~The San Joaquin Valley Drainage Program should also investigate the plan to use the San Luis Drain (the Zahm-Sansoni Plan) as the first phase of this alternative.~~

~~4. The US Bureau of Reclamation should give the districts and growers subject to this program first priority in their water conservation loan program.~~

6. The selenium water quality objective for the wetland channels can not be achieved without removal of drainage water from these channels. The present use of the Grassland channels has developed over a 30-year period through agreements between the dischargers, water and irrigation districts, the U.S. Bureau of Reclamation, the California Department of Water Resources, the U.S. Fish and Wildlife Service, the California Department of Fish and Game, the Grassland Water District and the Grassland Resource Conservation District. Because each entity shared in the development of the present drainage routing system, each shares the responsibility for implementation of a wetlands bypass.

* * * * *

# ACTIONS AND SCHEDULE TO ACHIEVE WATER QUALITY OBJECTIVES

The Regional Water Board expects to implement the actions identified below over the fiscal year (FY) period 1993/1994 through 1995/1996. The problems to which the actions respond were identified as a result of the Regional Water Board's 1993 Triennial Review. The actions and schedules assume that the Regional Water Board has available a close approximation of the mix and level of resources it had in FY 1993/1994. The actions are identified by major water quality problem categories.

## Agricultural Drainage Discharges in the San Joaquin River Basin

Water quality in the San Joaquin River has degraded significantly since the late 1940s. During this period, salt concentrations in the River, near Vernalis, have doubled. Concentrations of boron, selenium, molybdenum and other trace elements have also increased. These increases are primarily due to reservoir development on the east side tributaries and upper basin for agricultural development, the use of poorer quality, higher salinity, Delta water in lieu of San Joaquin River water on west side agricultural lands and drainage from upslope saline soils on the west side of the San Joaquin Valley. The water quality degradation in the River was identified in the 1975 Basin Plan and the Lower San Joaquin River was classified as a Water Quality Limited Segment. At that time, it was envisioned that a Valley-wide Drain would be developed and these subsurface drainage water flows would then be discharged outside the Basin, thus improving River water quality. However, present day development is looking more toward a regional solution to the drainage water discharge problem rather than a valley-wide drain.

Because of the need to manage salt and other pollutants in the River, the Regional Water Board began developing a Regional Drainage Water Disposal Plan for the Basin. The development began in FY 87/88 when Basin Plan amendments were considered by the Water Board in FY 88/89. The amendment development process included review of beneficial uses, establishment of water quality objectives, and preparation of a regulatory plan, including a full implementation plan. The regulatory plan emphasized achieving objectives through reductions in drainage volumes and pollutant loads through best management practices and other on-farm methods. Additional regulatory steps will be considered based on achievements of water quality goals and securing of adequate resources.

The amendment emphasized toxic elements in subsurface drainage discharges. The Regional Water Board however still recognizes salt management as the most serious long-term issue on the San Joaquin River. The Regional Water Board will continue as an active participant in the San Joaquin River Management Program implementation phase, as authorized by AB 3048, to promote salinity management schemes including time discharge releases, real time monitoring and source control.

Per the amendment to the Basin Plan for San Joaquin River subsurface agricultural drainage, approved by the State Water Board in Resolution No. ~~89-88~~ and incorporated herein, the following actions will be implemented.

1. In developing control actions for selenium, the Regional Board will utilize a priority system which focuses on a combination of sensitivity of the beneficial use to selenium and the environmental benefit expected from the action.

2. Control actions which result in selenium load reduction are most effective in meeting water quality objectives.

3. With the uncertainty in the effectiveness of each control action, the regulatory program will be conducted as a series of short-term actions that are designed to meet long-term water quality objectives.

~~4. Best management practices, principally water conservation measures, are applicable to the control of agricultural subsurface drainage.~~

4. Performance goals will be used to measure progress toward achievement of water quality objectives for selenium. Prohibitions of discharge and waste discharge requirements will be used to control agricultural subsurface drainage discharges containing selenium. Compliance with performance goals and water quality objectives for nonpoint sources will occur no later than the dates specified in Table IV-4.

**Table IV-4. Summary of Selenium Water Quality Objectives and Compliance Time Schedule**

**Selenium Water Quality Objectives (in bold) and Performance Goals (in italics)**

| Water Body/Water Year Type[1] | 1 October 1996 | 1 October 2002 | 1 October 2005 | 1 October 2010 |
|---|---|---|---|---|
| Salt Slough and Wetland Water Supply Channels listed in Appendix 40 | **2 µg/L monthly mean** | | | |
| San Joaquin River below the Merced River; Above Normal and Wet Water Year types[1] | | *5 µg/L monthly mean* | **5 µg/L 4-day avg.** | |
| San Joaquin River below the Merced River; Critical, Dry, and Below Normal Water Year types | | *8 µg/L monthly mean* | *5 µg/L monthly mean* | **5 µg/L 4-day avg.** |
| Mud Slough (north) and the San Joaquin River from Sack Dam to the Merced River | | | | **5 µg/L 4-day avg.** |

[1] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level (Department of Water Resources Bulletin 120). The previous water year's classification will apply until an estimate is made of the current water year.

5. Waste discharge requirements may be used to control agricultural subsurface drainage discharges containing toxic trace elements, if water quality objectives are not continuously achieved beginning with the following dates:

January 1989 -- Molybdenum

~~October 1989 -- Selenium:~~
~~Water supply channels for Grassland Water District and State and federal refuges~~

October 1991 -- ~~Selenium and b~~Boron:
San Joaquin River, mouth of the Merced River to Vernalis

October 1993 -- ~~Selenium and b~~Boron:
Salt Slough, Mud Slough (north), and the San Joaquin River from Sack Dam to the mouth of the Merced River.

6. ~~Milestones to the achievement of water quality objectives for selenium were used.~~

6. Selenium load reduction milestones will be incorporated into waste discharge requirements as effluent limits as necessary to ensure that:

   a. the selenium water quality objective in the San Joaquin River downstream of the Merced River inflow is achieved.

   b. Clean Water Act requirements for the implementation of a TMDL are satisfied.

7. Effluent limits established in waste discharge requirements will be applied to the discharge of subsurface drainage water from the Grassland watershed. In the absence of a regional entity to coordinate actions on the discharge, the Regional Board will consider setting the effluent limits from each drainage water source (discharger) equal to the receiving water objectives to ensure that beneficial uses are protected at all points downstream.

8~~1.~~ Upslope irrigations and water facility operators whose actions contribute to subsurface drainage flows will participate in the program to control discharges ~~beginning in January 1989.~~

~~9. The Regional Water Board staff will prepare a study plan that identifies the information needed to reconsider selenium and boron objectives.~~

9~~7.~~ Public and private managed-wetlands will participate in the program to achieve water quality objectives.

10. Meeting load reduction milestones is highly dependent upon the effectiveness of individual actions or technology not currently available; therefore, the Regional Board will review the waste discharge requirements and compliance schedule at least every 5 years.

11~~3.~~ ~~Annual submittal and approval of drainage operations plans (DOP) is required from~~ All those discharging or contributing to the generation of agricultural subsurface drainage ~~from 1989 through 1993.~~ will be required to submit for approval a short-term (5-year) drainage management plan designed to meet interim milestones and a long-term drainage management plan designed to meet final water quality objectives.

12. An annual review of the effectiveness of control actions taken will be conducted by those contributing to the generation of agricultural subsurface drainage.

13~~8.~~ Evaporation basins in the San Joaquin Basin will be required to meet minimum design standards, have waste discharge requirements and be part of a regional plan to control agricultural subsurface drainage.

14. The Regional Board staff will coordinate with US EPA and the dischargers on a study plan to support the development of a site specific selenium water quality objective for the San Joaquin River and other effluent dominated waterbodies in the Grassland watershed.

15~~2.~~ The Regional Board will ~~reconsider site-specific water quality objectives for selenium and boron for Mud Slough (north), Salt Slough and the San Joaquin River, Sack Dam to Vernalis as needed and~~ establish water quality objectives for salinity for the San Joaquin River. ~~based upon the final Delta Plan that is approved by the State Water Board and USEPA.~~

~~The Regional Water Board is currently in the process of updating and revising the implementation plan to control agricultural subsurface drainage.~~

* * * * *

# ESTIMATED COSTS OF AGRICULTURAL WATER QUALITY CONTROL PROGRAMS AND POTENTIAL SOURCES OF FINANCING

## SAN JOAQUIN RIVER SUBSURFACE AGRICULTURAL DRAINAGE CONTROL PROGRAM

The estimates of capital and operational costs to achieve the selenium objective for the San Joaquin River ~~and wildlife areas~~ range from ~~approximately four to nine million dollars per year (1988 dollars). A more detailed estimate is given in Table 6, Exhibit A, of Resolution No. 88-195.~~ \$3.6 million/year to \$27.4 million/year (1990 dollars). The cost of meeting water quality objectives in Mud Slough (north), Salt Slough, and the wetland supply channels is approximately \$2.7 million /year (1990 dollars).

Potential funding sources include:

1. Private financing by individual sources.
2. Bonded indebtedness or loans from governmental institutions.
3. Surcharge on water deliveries to lands contributing to the drainage problem.
4. Ad Valorem tax on lands contributing to the drainage problem.
5. Taxes and fees levied by a district created for the purpose of drainage management.
6. State or federal grants or low-interest loan programs.
7. Single-purpose appropriations from federal or State legislative bodies (including land retirement programs).

* * * * *

This chapter describes the methods and programs that the Regional Water Board uses to acquire water quality information. Acquisition of data is a basic need of a water quality control program and is required by both the Clean Water Act and the Porter-Cologne Water Quality Control Act.

The Regional Water Board's surveillance and monitoring efforts include different types of sample collection and analysis. Surface water surveillance may involve analyses of water, sediment, or tissue samples and ground water surveillance often includes collection and analysis of soil samples. Soil, water, and sediment samples are analyzed via standard, EPA approved, laboratory methods. The Regional Water Board addresses quality assurance through bid specifications and individual sampling actions such as submittal of split, duplicate, or spiked samples and lab inspections.

Although surveillance and monitoring efforts have traditionally relied upon measurement of key chemical/physical parameters (e.g., metals, organic and inorganic compounds, bacteria, temperature, and dissolved oxygen) as indicators of water quality, there is increasing recognition that close approximation of water quality impacts requires the use of biological indicators. This is particularly true for regulation of toxic compounds in surface waters where standard physical/chemical measurement may be inadequate to indicate the wide range of substances and circumstances able to cause toxicity to aquatic organisms. The use of biological indicators to identify or measure toxic discharges is often referred to as *biotoxicity testing*. EPA has issued guidelines and technical support materials for biotoxicity testing. A key use of the method is to monitor for compliance with narrative water quality objectives or permit requirements that specify that there is to be no discharge of toxic materials in toxic amounts. The Regional Water Board will continue to use biotoxicity procedures and testing in its surveillance and monitoring program.

As discussed previously, the protection, attainment, and maintenance of beneficial uses occur as part of a continuing cycle of identifying beneficial use impairments, applying control measures, and assessing program effectiveness. The Regional Water Board surveillance and monitoring program provides for the collection, analysis, and distribution of the water quality data needed to sustain its control program. Under ideal circumstances, the Regional Water Board surveillance and monitoring program would produce information on the frequency, duration, source, extent, and severity of beneficial use impairments. In attempting to meet this goal, the Regional Water Board relies upon a variety of measures to obtain information. The current surveillance and monitoring program consists primarily of seven elements:

**Data Collected by Other Agencies**

The Regional Water Board relies on data collected by a variety of other agencies. For example, the Department of Water Resources (DWR) has an ongoing monitoring program in the Delta and the United States Geological Survey (USGS) and DWR conduct monitoring in some upstream rivers. The Department of Fish and Game, Fish and Wildlife Service, USGS, and Department of Health Services also conduct special studies and collect data.

**Regional Water Board and State Water Board Monitoring Programs**

The State Water Board manages its own Toxic Substances Monitoring (*TSM*) program to collect and analyze fish tissue for the presence of bioaccumulative chemicals. The Regional Water Board participates in the selection of sampling sites for its basins and annually is provided with a report of the testing results.

**Special Studies**

Intensive water quality studies provide detailed data to locate and evaluate violations of receiving water standards and to make waste load allocations. They usually involve localized, frequent and/or continuous sampling. These studies are specially designed to evaluate problems in potential water quality limited segments, areas of special biological significance or hydrologic units requiring sampling in addition to the routine collection efforts.

One such study is the *San Joaquin River Subsurface Agricultural Drainage Monitoring Program*. The program includes the following tasks:

1. The dischargers will monitor discharge points and receiving waters for constituents of concern and

flow (discharge points and receiving water points ~~only~~).

~~2. The Regional Water Board will continue to monitor the major discharges, tributaries and the San Joaquin River.~~

2. The Regional Board will inspect discharge flow monitoring facilities and will continue its cooperative effort with dischargers to ensure the quality of laboratory results.

~~3. The Regional Water Board will continue its investigations into pollutant transport mechanisms and sinks.~~

3. The Regional Board will, on a regular basis, inspect any facilities constructed to store or treat agricultural subsurface drainage.

~~4. The Regional Water Board will inspect discharger monitoring and treatment facilities.~~

4. The Regional Board will continue to maintain and update its information on agricultural subsurface drainage facilities in the Grassland watershed. Efforts at collecting basic data on all facilities, including flow estimates and water quality will continue.

5. The Regional Water Board, in cooperation with other agencies, will regularly assess water conservation achievements ,~~and compile cost and drainage reduction effectiveness information~~ cost of such efforts and drainage reduction effectiveness information. In addition, in cooperation with the programs of other agencies and local district managers, the Regional Board will gather information on irrigation practices, i.e., irrigation efficiency, pre-irrigation efficiency, excessive deep percolation and on seepage losses.

**Aerial Surveillance**

Low-altitude flights are conducted primarily to observe variations in field conditions, gather photographic records of discharges, and document variations in water quality.

**Self-Monitoring**

Self-monitoring reports are normally submitted by the discharger on a monthly or quarterly basis as required by the permit conditions. They are routinely reviewed by Regional Water Board staff.

**Compliance Monitoring**

Compliance monitoring determines permit compliance, validates self-monitoring reports, and provides support for enforcement actions. Discharger compliance monitoring and enforcement actions are the responsibility of the Regional Water Board staff.

**Complaint Investigation**

Complaints from the public or governmental agencies regarding the discharge of pollutants or creation of nuisance conditions are investigated and pertinent information collected.

* * * * *

# APPENDIX DIRECTORY (continued)


| ITEM* | DESCRIPTION |
|---|---|
| 36. | Regional Water Board Guidelines for Disposal from Land Developments |
| 37. | Regional Water Board Guidelines for Mining |
| 38. | Regional Water Board list of Water Quality Limited Segments |
| 39. | Federal Anti-degradation policy (40 CFR |
| 40. | Grassland Watershed Wetland Channels |


* Appendix items are paginated by: item number/item page/item total pages

**Appendix 40 - Grassland Watershed Wetland Channels for Which Beneficial Uses Have Been Identified**

**Southern Grassland Wetland Channels**

| | Starting Location | Ending Location |
|---|---|---|
| Agatha Canal North | Starts at the Agatha North/Geis split at NE1/4, SE1/4, SE1/4, Sec. 12, T11S, R11E | Discharges to the Santa Fe Canal at Mueller Weir at NW1/4, SW1/4, SW1/4, Sec. 21, T10S, R11E |
| Agatha Canal South | Diversion from Helm or Main Canal at NW1/4, SE1/4, NE1/4, Sec. 31 T11S, R12E | Terminates at the Agatha North/Geis split at NE1/4, SE1/4, SE1/4, Sec. 12, T11S, R11E |
| Almaden Ditch | Begins at the Agatha Canal at Mallard Rd at SE1/4, NE1/4, SE1/4, Sec. 12, T11S, R11E | Terminates at Mesquite Drain siphon at the SW1/4, SW1/4, SW1/4, Sec. 11, T11E, R11E |
| Almond Drive Ditch | Diversions from the Main Canal and Main Drain at the SW1/4, SW1/4, SW1/4, Sec. 6, T11S, R10E | Discharges to Reedly Ditch at SW1/4, SW1/4, SW1/4, Sec. 5, T11S, R10E |
| Ascot Ditch | Diversion from the Main Canal at the SE1/4, SW1/4, SW1/4, Sec. 7, T11S, R11E | Terminates at the SW1/4, SE1/4, SE1/4, Sec. 8, T11S, R11E |
| Britto Ditch | Diversion from Camp 13 at the NW1/4, SE1/4, NE1/4, Sec. 22, T11S, R11E | Terminates at the SW1/4, SE1/4, NE1/4, Sec. 10, T11S, R11E |
| Camp 13 | Diversion of the Main Canal or Main Drain or Hamburg Drain at the SW1/4, SE1/4, SE1/4, Sec. 27, T11S, R11E, | Discharges to Mud Slough (south) at the SE1/4, NE1/4, NE1/4, Sec. 33, T10S, R11E |
| Charleston Drain | Freshwater diversions from the Outside Canal at the SW1/4, SW1/4, NE1/4, Sec. 32, T11S, R11E | Discharges to Upper Gadwall Ditch at the SW1/4, SW1/4, NW1/4, Sec. 6, T11S, R11E |
| Cooke Ditch | Diversion from the Arroyo Canal at the NE1/4, SW1/4, SW1/4, Sec. 21, T10S, R11E | Terminates at the NW1/4, SE1/4, SE1/4, Sec. 16, T10S, R11E |
| Colony Branch 2 | Enters the Southern Grassland at the SW1/4, NW1/4, SW1/4, Sec. 8, T11S, R12E | Drains into Bennett Drain at the NE1/4, SE1/4, NE1/4, Sec. 7, T11S, R12E |
| Colony Branch 3/Bennett | Enters the Southern Grassland at the SE1/4, SW1/4, SW1/4, Sec. 5, T11S, R12E | Terminates at the Agatha Canal North at the SW1/4, SW1/4, SW1/4, Sec. 6 T11S, R12E |
| Cotton Drain | Enters the Grassland at the NW1/4, NE1/4, SE1/4, Sec. 32, T10S, R11E | Discharges to Mud Slough (s) at the SE1/4, SW1/4, SE1/4, Sec. 28, T10S, R11E |

| | Starting Location | Ending Location |
|---|---|---|
| Flyway Ditch | Diversion from Almond Dr. Ditch at SE1/4, SW1/4, SW1/4, Sec. 5, T11S, R11E | Discharges to Cotton Drain at the NW1/4, SE1/4, NE1/4, Sec. 32, T10S, R11E |
| Gables Ditch | Diversion of Main Canal at the NE1/4, NW1/4, NW1/4, Sec. 31, T11S, R12E | Terminates at the SW1/4, NW1/4, SW1/4, Sec. 18, T11S, R12E |
| Geis Ditch | Begins at the Agatha North/Geis split at the NE1/4, SE1/4, SE1/4, Sec. 12, T11S, R11E | Discharges to Camp 13 at NW1/4, NW1/4, SW1/4, Sec. 3, T11S, R11E |
| Helm Canal | Takeouts from the Main Canal at NE1/4, SE1/4, NE1/4, Sec. 31, T11S, R11E | Terminates at the Helm Canal extension at the SW1/4, SW1/4, NW1/4, Sec. 26, T11S, R11E |
| Line Ditch | Enters Grassland at the SW1/4, SE1/4, NE1/4, Sec. 5, T11S, R12E | Terminates at the NE1/4, NE1/4, NE1/4, Sec. 6, T11S, R12E |
| Lower Gadwall Canal | Continuation of the upper Gadwall, starts at the Almond Dr. intersection at the SE1/4, SE1/4, SE1/4, Sec. 5, T11S, R11E | Discharges to Mud Slough (south) at the NE1/4, NE1/4, NW1/4, Sec. 33, T10S, R11E |
| Meyers Ditch | Diversion from Helm Canal at SE1/4, SW1/4, SW1/4, Sec. 26, T11S, R11E | Terminates at the SE1/4, SW1/4, SW1/4, Sec. 23, T11S, R11E |
| Mud Slough (south) | Begins at the end of Camp 13 at the SE1/4, NE1/4, NE1/4, Sec. 33, T10S, R11E | Discharges to Salt Slough at the Los Banos WA at the NW1/4, NE1/4, SW1/4, Sec. 18, T9S, R10E |
| Pozo Drain | Enters the GWD at SW1/4, SW1/4, SW1/4, Sec. 8, T11S, R12E | Discharges to the Agatha Canal North at the NE1/4, SE1/4, NE1/4 Sec. 12, T11S, R12E |
| Reedly Ditch | Continuation of Almond Dr. Drain at the SW1/4, SW1/4, SW1/4, Sec. 4, T11S, R11E | Discharges to Camp 13 at the SE1/4, SE1/4, SE1/4, Sec. 4, T11S, R11E |
| San Pedro Canal | Diversion from the Arroyo Canal at the NW1/4, NE1/4, NW1/4, Sec. 26, T10S, R11E | Discharges to Boundary/ Devon Drain at the NE1/4, NE1/4, SE1/4, Sec. 31, T9S, R11E |
| SLCC Arroyo Canal | Enters the Southern Grassland at the NE1/4, SE1/4, NE1/4, Sec. 25, T10S, R11E | Discharges to the Santa Fe Canal at Mueller Weir at the NW1/4, SW1/4, SW1/4, Sec. 21, T10S, R11E |
| Sorsky Ditch | Diversion of Camp 13 and continuation of Sorsky Bypass at the NE1/4, NW1/4, NW14, Sec. 27, T11S, R11E | Discharges to Camp 13 at SW1/4, SW1/4, SW1/4, Sec. 3 T11S, R11E |
| Stillbow Ditch | Begins at Bennett Ditch at the SW1/4, SE1/4, SW1/4, Sec. 6, T11S, R12E | Discharges to the Agatha Canal North at the SW1/4, NW1/4, NW1/4, Sec. 36, T10S, R11E |
| 240 Ditch | Diversion from Helm Canal at NE1/4, NW1/4, NW1/4, Sec. 36, T11S, R11E | Terminates at Sorsky Ditch at NE1/4, NW1/4, NE1/4, Sec. 23, T11S, R11E |
| Upper Gadwall Ditch | Diversion of Camp 13 at the NW1/4, SE1/4, SE1/4, Sec. 22, T11S, R11E | Terminates at Reedly Ditch at the NE1/4, NE1/4, NE1/4, Sec. 8, T11S, R11E |

## Northern Grassland Wetland Channels

| | Starting Location | Ending Location |
|---|---|---|
| Eagle Ditch | Diversion of the Santa Fe Canal at the NE 1/4, SE 1/4, NE 1/4, Sec. 30, T.8S, R.10E | Discharges to Mud Slough (north) at the SW 1/4, SE 1/4, NE 1/4, Sec. 7, T.8S, R.9E |
| Fremont Ditch | Diversion from San Luis Canal at the SE 1/4, SW 1/4, SW 1/4, Sec. 35, T.8S, R.10E | Discharges to Mud Slough (north) at the NW 1/4, NW 1/4, NE 1/4, Sec. 20, T.8S, R.10 |
| Garzas Creek | Enters Grassland Water District (GWD) at the intersection of Sections 22, 23, 26,27 T.8S, R.9E | Discharges to Los Banos Creek NE 1/4, NE 1/4, NE 1/4, Sec. 26, T.8S, R.9E |
| Gun Club Road Ditch | Diversion of Los Banos Cr at the intersections of Sections 13, 14, 23, 24, T.8S, R.9E | Terminates at Eagle Ditch at the SW 1/4, SE 1/4, SE 1/4, Sec. 13, T.8S, R.9E |
| Kesterson Ditch | Diversion of the Santa Fe Canal at the SE 1/4, SE 1/4, SW 1/4, Sec. 32, T.8S, R.10E | Terminates at the NW 1/4, NW 1/4, SE 1/4, Sec. 34, T.8S, R.10E |
| Los Banos Creek | Begins service at CCID Main Canal at the SE 1/4, SW 1/4, SW 1/4, Sec. 9, T.10S., R.10E | Discharges to Mud Slough (north) at the NE 1/4, NW 1/4, SW 1/4, Sec. 26, T.7S, R.9E |
| Mosquito Ditch | Diversion from the San Luis Wasteway at the NE 1/4, NW 1/4, NW 1/4, Sec. 19, T.9S, R.10E | Discharges to Los Banos Creek at NE 1/4, NE 1/4, SE 1/4, Sec. 6, T.9S, R10E |
| Rubino Ditch | Diversion of the San Luis Spillway at the SW 1/4, SE 1/4, SW 1/4, Sec. 17, T.9S, R.10E | Terminates at the NW 1/4, SW 1/4, SW 1/4, Sec. 8, T.9S, R.10E |
| San Luis Canal | Starts at a diversion of the Main Canal at NE 1/4, NW 1/4, SW 1/4, Sec. 36, T.10S, R.10E | NE 1/4, NE 1/4, SW 1/4, Sec. 5, T.8S, R.10E |
| San Luis Spillway Ditch | Diversion of the San Luis Wasteway at the intersections of Sections 17, 18, 19, 20, T.9S, R.10E | Discharges to the Santa Fe Canal at SE 1/4, SE 1/4, SW 1/4, Sec. 16, T.9S, R.10E |
| San Luis Wasteway[2] | | |
| Standard Ditch | Diversion from San Luis Canal at the NE 1/4, SE 1/4, NE 1/4, Sec. 25, T.9S, R.10E | Terminates at the NE 1/4, NE 1/4, SW 1/4, Sec. 15, T.9S, R.10E |
| Santa Fe Canal[1] | Extension of the Arroyo Canal at Mueller Weir at the NW 1/4, SW 1/4, SW 1/4, Sec. 21, T.10S, R.11E | Terminates at a tributary of Mud Slough (north) at the SW 1/4, SW 1/4, SE 1/4, Sec. 7, T.8S, R.10E |
| Santa Fe Canal Extension | Diversion of the Santa Fe Canal at the SW 1/4, Sec. 7, T.8S, R.10E | |
| Westside Ditch | Diversion of Garzas Cr at the intersection of Sections 22, 23, 26, 27, T.8S, R.9E | Discharges to Los Banos Creek at the SE 1/4, NW 1/4, NW 1/4, Sec. 11, T.8S, R.9E |

[1] Begins as an extension of the Arroyo Canal. Receives only SLCC operational spill water at this point.
[2] Source is the Delta-Mendota Canal.

# PART III BENEFICIAL USES

A staff report on the beneficial uses designations for Grassland watershed water bodies (CVRWQCB, 1995a) was the subject of a public workshop conducted on 23 June 1995. Comments were solicited from stakeholders, which included affected parties (e.g. water, drainage, and reclamation districts), county health and environmental agencies, and State (e.g. Department of Fish and Game, Department of Water Resources) and Federal agencies (e.g. Department of Fish and Wildlife Service, U.S. Environmental Protection Agency) with jurisdiction over resources in the region, and environmental groups with a history of involvement in agricultural drainage issues or resources potentially impacted. Additionally, consultation was initiated with the Department of Fish and Game on the California Endangered Species Act (CESA). Comments received during the workshops and were used in formulating this final version of the staff report and the proposed basin plan amendment.

In taking regulatory actions, the Regional Board must first develop a water quality control plan. A water quality control plan entails *designation or establishment for the waters within a specified area of all of the following: 1) beneficial uses to be protected. 2) water quality objectives. 3) a program of implementation needed for achieving water quality objectives* (Porter-Cologne §13050(j)). This portion of the staff report discusses the beneficial uses proposed for Mud Slough (north), Salt Slough, and the wetland supply channels in the Grassland watershed which are identified in Appendix 1.

## ALTERNATIVES CONSIDERED

Procedures used in identifying beneficial uses are specified in the California Water Code and in the Clean Water Act.

Beneficial uses that may be protected include, but are not limited to, *domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation of fish, wildlife, and other aquatic resources or preserves* (Water Code § 13050(f)). The Water Code (§13241) requires the Regional Board to consider, among other things, *the past, present and probable future beneficial uses of water and the water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.* Additionally, §13263(g) clarifies the use of a water body for waste discharge as it states that *all discharges of waste into waters of the state are privileges and not rights* and that no discharge of waste, whether permitted or not constitutes a right to continue that discharge. As such, waste discharge, assimilation, and transport are not recognized beneficial uses under state statutes.

The Federal Clean Water Act requires states to include existing uses and those that are deemed attainable. Existing uses are defined as those uses actually attained in the water body on or after November 28, 1975 (40 CFR §131.3(e)). Uses are deemed attainable if they can be achieved by the imposition of effluent limits required under Section 301(b) and 306 of the Act and cost-effective and reasonable best management practices for non-point source control (40 CFR §131.10(d)).

State law requires consideration of past uses in designating beneficial uses. Federal regulations requires that existing uses be included as designated uses. Existing uses are defined, in the federal regulations, as uses which existed at any period since November 28, 1975, whether or not that use is currently being attained. The November 28, 1975 date, in the federal regulations, is important as it sets the baseline from which uses are evaluated and sets the time frame from which to evaluate past uses.

Two alternatives were considered with respect to the identification of beneficial uses of Grassland watershed water bodies: 1) no action; and 2) a survey and analysis and formal identification of beneficial uses. The selection of the recommended alternative was based on: 1) compliance and consistency with State and Federal statutes, regulations, and directives; and 2) identification of appropriate beneficial uses. A discussion of the two alternatives, the recommended alternative, and factors influencing appropriate beneficial uses follows.

Alternative 1 - No Action

The basin plan divides the surface water system of a basin into specific surface water bodies and identifies existing and potential beneficial uses for these water bodies. Not all surface water features are formally identified. For the Grassland watershed, none of the water bodies have been specifically listed in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan) (CVRWQCB, 1995d) nor have beneficial uses been formally identified through the process of a survey or assessment. Rather, the Basin Plan assumes beneficial uses listed for a segment of the San Joaquin River (Sack Dam to the mouth of the Merced River) apply to several of the Grassland watershed channels including Mud Slough (north) and Salt Slough. The Basin Plan states that "the beneficial uses of any specifically identified water body generally apply to its tributary streams." This process provides the means of regulating unlisted water bodies for the protection of downstream water uses until beneficial uses can be evaluated "on a case-by-case basis" (CVRWQCB, 1995d). In selecting the "no action" alternative, the Regional Board would assume the beneficial uses of the San Joaquin River apply to Mud Slough (north) and Salt Slough and the wetland supply channels.

Alternative 2 - Survey and Analysis

In order to replace the assumed beneficial uses, the Regional Board may perform a survey and assessment of all past, present, and probable beneficial uses and amend the Basin Plan (Jennings, 1994). A survey and analysis entails compiling and reviewing current and historic chemical, physical, and biological data of a water body to assess the past, present, and potential uses of that water body. These uses are compared to defined beneficial uses in the Basin Plan and the appropriate beneficial uses are identified for the water body.

Recommended Alternative

Based on the selection criteria identified above, the second alternative (survey and analysis) was deemed to be the appropriate approach. Selection of alternative 1 (the no action alternative) would have resulted in assuming the beneficial uses of a segment of the San Joaquin River (Sack

Dam to the mouth of the Merced River) applied to Mud Slough (north), Salt Slough, and the wetland channels. These uses may not be appropriate because of the differences in geology and hydrology of the watersheds that provide the primary source of flow for the San Joaquin River, as compared to the watershed that drains into Mud Slough (north) and Salt Slough and other Grassland channels. In addition, the present physical and chemical character of the sloughs has evolved from the hydrology of flooding and natural fluvial processes to a managed and effluent-dominated system. Current uses of Mud Slough (north) and Salt Slough have developed from discharges to the sloughs, mainly agricultural and wetland drainage. The sloughs have evolved into effluent-dominated water bodies. The beneficial uses of wetland water supply channels are governed by wetland management practices including water deliveries and drainage of wetlands. These channels are constructed or highly modified natural channels to aid in the management of manmade wetlands. The highly managed hydrology of these water bodies contrasts with the hydrology of the San Joaquin River and require a separate assessment for appropriate beneficial uses.

In addition, the State Water Resources Control Board directed the Regional Board, in 1989 (Resolution No. 89-88) to formally designate beneficial uses for Grassland watershed water bodies. Assuming the beneficial uses of the San Joaquin River from Sack Dam to the Merced River for Grassland watershed water bodies would not be in compliance with this directive.

Identified beneficial uses for the water bodies in the Grassland watershed (e.g. Mud Slough (north), Salt Slough, and the wetland supply channels) based on the survey and analysis are presented in this section. These identified uses were derived from an assessment of past, present, and future (potential) uses of these water bodies. This analysis is presented in more detail in another staff report (CVRWQCB, 1996 draft) and only the highlights are presented here.

**Factors Influencing Beneficial Uses**

The present level of beneficial uses of Mud Slough (north) and Salt Slough developed as a result of modifications of the natural hydrology. The level of beneficial use in the wetland channels developed as a result of the physical characteristics (e.g. channel morphology) of the constructed channels and of wetland management practices.

Mud Slough (north) and Salt Slough along with the remainder of the San Joaquin River Basin have undergone dramatic changes in their hydrology and water quality in the past century, due to agricultural development and alteration of the natural hydrology. In its pristine state, portions of the Grassland watershed (basin trough and rim) were subject to annual flooding from the San Joaquin River followed by drainage, which created a landscape of seasonal and permanent wetlands and upland grassland. These wetlands formed critical habitat for migratory and resident waterfowl. The drainage of flood water was the principal source of flow for Mud Slough (north) and Salt Slough. With the expansion of agriculture, increasing levels of flood control and water diversion were implemented in the region. Alterations to the native environment began in the late 1800s and culminated with completion of most elements of the Central Valley Project (CVP) in the early 1950s. The impacts of the CVP project on the Grassland watershed included:

- cessation of annual flooding of the Grassland watershed basin trough and rim;

- loss of the principal source of natural flow for Mud Slough (north) and Salt Slough;

- introduction of poorer quality water (higher salinity) imported from the Delta to the Grassland watershed;

- increased intensity of irrigation of agricultural land in the western portion of the watershed which resulted in the raising of the water table and the need for subsurface drainage; and

- alteration and destruction of the natural aquatic habitat.

Construction of Friant Dam and other flood control structures, including those on the westside streams, along with diversions of the upper San Joaquin River to areas outside of the San Joaquin River Basin, resulted in cessation of annual flooding of the San Joaquin River in the Grassland watershed. The lack of annual flooding resulted in the loss of the principal source of flow for Mud Slough (north) and Salt Slough and loss of water which created the wetlands. To replace water supplies lost from diversion of the upper San Joaquin River, water was imported to the Grassland watershed from the Sacramento-San Joaquin River Delta via the Delta-Mendota Canal. This replacement water supply is used for agricultural production and to artificially maintain a portion of the former wetlands. These wetlands are maintained for waterfowl habitat in private duck hunting clubs and public wildlife refuges.

Water from the upper San Joaquin River originates in the Sierra Nevada and is of good quality (low salinity, turbidity, alkalinity) due to the geology (mainly granitic) of this mountain range. In contrast, water from the Delta that is transported in the Delta-Mendota Canal is of poorer quality (higher salinity, turbidity, and alkalinity) because it originates in an estuary and because of influences of agricultural return flows prior to its diversion.

Water supplies from the Delta-Mendota Canal were also directed to the western portion of the Grassland watershed. This area did not formerly have a surface water supply. This water diversion permitted more intensive irrigation of these lands. Much of this area is now known as the Drainage Problem Area and is located on the Panoche alluvial fan. The marine sediment influences on the Panoche alluvial fan soils are reflected in their saline character and elevated trace element concentrations including, selenium. Irrigation of soils in the Drainage Problem Area, as a result of water supplies introduced by the Delta-Mendota Canal, has resulted in mobilization of trace elements and salts to the groundwater. Irrigation has also resulted in raising the water table, which has necessitated the installation of subsurface drainage systems. Agricultural subsurface drainage from this area is the principal source of selenium and salts in Grassland watershed waterways. The water quality characteristics of the sloughs is a combination of the chemistry of the soils from which the drainage originates and of the Sacramento-San Joaquin Delta water quality.

The natural hydrology of the Grassland watershed has been altered to serve the needs of the various land uses within the Grassland watershed. Natural channels and highly altered natural channels are interconnected with constructed channels through diversion structures and gates in order to convey water supplies from the CVP at the upstream end of the watershed to agricultural lands and wetlands. Wastewater (agricultural surface and subsurface drainage, wetland drainage, storm water runoff, and wastewater treatment plant discharges) is conveyed to Mud Slough (north) or Salt Slough and then to the San Joaquin River, at the downstream end of the watershed through many of the same channels used for freshwater deliveries.

The impacts to Mud Slough (north) and Salt Slough of the alteration of the natural hydrology has been the loss of the principal source of natural flow in the sloughs, which has resulted in a profound decrease in flow. Second, the water quality characteristics of the sloughs has been greatly altered because in their present state, the sloughs merely serve as a conveyance system for agricultural and wetland waste waters to the San Joaquin River. These waste waters are characterized by elevated trace element and salt concentrations, turbidity, and alkalinity. Because flows in Mud Slough (north) and Salt Slough now have a different origin from those in the main stem of the San Joaquin River, the sloughs support different beneficial uses than the San Joaquin River.

The preceding discussion has demonstrated that the landscape of the Grassland watershed and quantity and quality of water in the sloughs has been greatly altered as a result of hydrological modifications and changing land use practices. These alterations led to changes in the environment and in the level of beneficial uses supported. An example is the impact these hydrological modifications have had on the fisheries resources of the San Joaquin Valley, including the fisheries in the water bodies of the Grassland watershed. Alteration of the natural hydrology has resulted in the destruction of the natural aquatic habitat; a principal reason for the disappearance of native fish species from the San Joaquin Basin. The introduction of exotic species has also been credited, to a lesser extent for the changing fish distributions in the San Joaquin Basin. Introduced species have adapted to the altered environment and have flourished, while the native species have not. Additionally, introduced species compete for limited food resources and habitat with the native species and in some limited cases have out competed the native species to the point of elimination (Moyle, 1976).

Unlike Mud Slough (north) and Salt Slough, the wetland channels are either constructed or re-constructed channels designed for the specific purpose of managing wetlands. The level of beneficial uses in these channels has developed as a result of the water management practices and physical characteristics of the channels. The channels are similar in that they are earthen lined straight, steeply banked and lack the features of natural streams, such as meanders, pools, riffles, shallows, etc. The wetland channels differ in function and physical characteristics, primarily with respect to the quantity and quality of water conveyed and channel capacity. Some channels convey primarily water supplies and generally have continuous flow while other channels convey both wetland water supplies and agricultural drainage. Many channels are subject to frequent periods of dryness. The physical characteristics and managed hydrology of the wetland channels sets them apart from natural water bodies and limits the attaintment of aquatic life beneficial uses.

Table 1 lists the definition of beneficial uses that were evaluated for Mud Slough (north), Salt Slough and the wetland channels. This list was selected from the Basin Plan for the Sacramento River and San Joaquin River Basin (CVRWQCB, 1995d) and includes beneficial uses of the San Joaquin River for the segment between Sack Dam and the mouth of the Merced River (Table II-1, CVRWQCB, 1995a). This list also includes beneficial uses which the Regional Board was directed to consider in State Water Resources Control Board Resolution 89-88 and uses likely to be present.

In evaluating the beneficial uses defined in Table 1, it became apparent that some of the uses could not be fully supported as defined. A case in point is the limitations posed by fluctuating water levels and periods of dryness for the constructed and reconstructed wetland channels to fully support aquatic life uses. Also, water quality limitations due to naturally elevated salt and boron concentrations in Mud Slough (north) and the wetland channels may not support all agricultural uses. In evaluating uses that may not be fully supported, the Regional Board considered subcategories of the use as an alternative. Considerations of subcategories of uses is appropriate as outlined in the water quality standards regulation (40 CFR 131.10(c)). A discussion of the subcategories considered are discussed in the evaluations that follow. Data is presented that outlines the limitations and supports the subcategories selected.

In the evaluation of the beneficial uses in the Grassland area water bodies, 1975 was set as the time frame to determine past and existing uses. This determination was based on two reasons: 1) consistency with the federal regulations; and 2) 1975 was the year the first basin plan for the San Joaquin River Basin was adopted. Staff has identified the beneficial uses of the wetland channels and of Mud Slough (north) and Salt Slough in compliance with the statutory and regulatory constraints identified earlier. A summary of the proposed beneficial uses is outlined in Table 2.

**Mud Slough (north) and Salt Slough**

Mud Slough (north) and Salt Slough are not on the list of water bodies in the Basin Plan with identified beneficial uses. The beneficial uses proposed for the sloughs in this Basin Plan amendment are intended to list these water bodies and to replace the assumed beneficial uses with those derived from a survey and assessment of past, present, and potential uses. Available historic chemical, physical, and biological data was compiled for the assessment. Some of this data dated back to 1938. Land use data (e.g. cropping and tile drainage statistics) were compiled to supplement historical data and to draw inferences regarding probable impacts of land uses on the beneficial uses of the sloughs where historical data was lacking.

Mud Slough (north) and Salt Slough are depicted in Figure 1. Mud Slough (north) originates at Kesterson Ditch[1] and meanders in a northerly direction, through the northern portion of the Grassland Water District to the San Joaquin River at approximately midway between the

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[1] At SW 1/4, NW1/4, NE1/4, Sec 33, T8S, R10E, MDB&M

TABLE 1: DEFINITION OF BENEFICIAL USES EVALUATED

| Beneficial Use | Abbreviation | Definition |
|---|---|---|
| Municipal and Domestic Supply | MUN | Uses of Water for community, military, or individual water supply system including, but not limited to, drinking water supply. |
| Industrial Service Supply | IND | Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well protection, or oil well pressurization |
| Industrial Process | PROC | Use of water for industrial activities that depend primarily on groundwater. |
| Agricultural Supply | AGR | Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing. |
| Water Contact Recreation | REC-1 | Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs. |
| Non-Contact Water Recreation | REC-2 | Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities. |
| Commercial and Sports Fishing | COMM | Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes. |
| Shellfish Harvesting | SHELL | Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes. |
| Warm Freshwater Habitat | WARM | Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including vertebrates. |
| Cold Freshwater Habitat | COLD | Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates. |
| Migration of Aquatic Organisms | MIGR | Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish. |
| Spawning, Reproduction, and/or Early Development | SPWN | Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish. |
| Wildlife Habitat | WILD | Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g. mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food resources. |
| Preservation of Habitats of Special Significance | BIOL | Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance, where the preservation or enhancement of natural resources requires special protection. |

**Table 2. Proposed Beneficial Uses for Mud Slough (north), Salt Slough, and Wetland Water Supply Channels Identified in Appendix 1**

| Surface Water Body | Water Use | | | | | Recreational | | | | | Fresh Water Aquatic Life | | | | | | Wildlife | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | IND | | AGR | | REC-1 | REC-2 | | COMM | SHELL | WARM | COLD | MIGR | | SPWN | | WILD | BIOL |
| | Municipal and Domestic Supply | Industrial Process | Industrial Service | Irrigation | Stock Watering | Contact | Non-contact | Canoeing | Sports Fishing | Shellfish Harvesting | Warm Water Habitat | Cold Water Habitat | Warm Water Species | Cold Water Species | Warm Water Species | Cold Water Species | Wildlife Habitat | Preserve |
| Mud Slough (north) | | | | ●[1] | ● | ● | ● | | ● | ● | ● | | | | ● | | ● | |
| Salt Slough | | | | ● | ● | ● | ● | | ● | ● | ● | | | | ● | | ● | ● |
| Wetland water supply channels[3] | | | | ●[1] | ● | | | | | | ●[2] | | | | | | ● | ● |

● Identified beneficial use

[1] Elevated natural salt and boron concentrations may limit this use to irrigation of salt and boron tolerant crops. Also intermittent low flow conditions may limit this use.
[2] Wetland channels can sustain aquatic life but due to fluctuating flow regimes and habitat limitations may not be suitable for rearing and propagation.
[3] Wetland water supply channels for which beneficial uses are being proposed are defined in Appendix 40.

Highway 140 bridge and the confluence with the Merced River[2]. Mud Slough (north) receives wetland drainage from surrounding duck clubs and wildlife reserves, subsurface drainage and tail water from upslope agriculture, operational spills and storm runoff. Mud Slough (north) also receives treated wastewater from the Gustine wastewater treatment plant through Los Banos Creek. The principal tributaries to Mud Slough (north) are Kesterson Ditch, Fremont Canal, Santa Fe Canal, and Los Banos Creek.

Salt Slough originates where Salt Slough Ditch and West Delta Drain meet and discharge through Sand Dam[3]. Salt Slough flows northwesterly and discharges to the San Joaquin River at river mile 129.7[4], about 4 miles upstream of the Mud Slough (north) discharge to the river. The principal tributaries of Salt Slough are Salt Slough Ditch, West Delta Drain, and Mud Slough (south). Sources of flow in Salt Slough include surface and subsurface agricultural drainage, operational spills, wetland drainage, and local runoff.

Table 2 summarizes the beneficial uses identified for the sloughs. Evaluation of the beneficial uses identified in Table 1 follows.

Municipal and Domestic Supply (MUN)

MUN use is not a current or previous use of the sloughs. Numerous factors restrict the development of this use. The agricultural and wetland drainage flows contain elevated salinity levels that often exceed Federal and State standards for drinking water. Additionally, these flows may contain pesticides and other contaminants of concern to public health, owing to their agricultural origins, and are not likely to be approved for drinking water supply by the Department of Health.

In absence of drainage discharges, water quality in Mud Slough (north) is poor due to elevated salinity concentrations and may not be suitable for MUN. This use is also restricted by low flow conditions. The State Water Resources Control Board (SWRCB) Sources of Drinking Water Policy (Resolution 88-63) exempts water with salinity greater than 5,000 $\mu$mhos/cm from MUN supply. Excursions above this limit have been observed in Mud Slough (north) during periods (Water Year 1993 and 1994) when no agricultural subsurface drainage was discharged to Mud Slough (north) (Chilcott et al, 1995, and Vargas et al. 1995).

With the elimination of agricultural subsurface drainage form Salt Slough, water quality will improve with respect to salinity and selenium. However, the slough will continue to convey agricultural surface drainage. Salt Slough is unlikely to be approved by the Department of Health Services as a drinking water source due to the presence of agricultural return flows which could potentially contain pesticides. Additionally, the SWRCB Sources Drinking Water Policy exempts water in systems designed or modified for the conveyance of agricultural drainage from municipal

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[2] At NW1/4, NE1/4, NW1/4, Sec 14, T7S, R9E, MDB&M

[3] At NW1/4, SE1/4, NE1/4, Sec 21, T9S, R11E, MDB&M

[4] At NE1/4, NE1/4, SW1/4, Sec 29, T7S, R10E, MDB&M

and domestic water supply. Thus, MUN is not an identified use of either Mud Slough (north) or Salt Slough.

Industrial Service (IND) and Industrial Process Supply (PROC)

Neither slough is utilized for these uses and there is no record that they have been utilized for these purposes, as there are no industrial facilities adjacent to the sloughs (Pierson et al., 1989a and b). Water quality conditions, such as high turbidity, salinity, and alkalinity may restrict industrial uses requiring certain water quality. Eliminating discharges (e.g. wetland and agricultural drainage) which contribute to these water quality conditions, would result in insufficient flow in the sloughs to support the industrial uses. Due to the irregular supply of water in the sloughs and the fluctuating water quality, with or without discharges, industrial uses are not likely to be realized. Thus, since IND and PROC uses are not current or past uses and do not have the potential to be realized, they are not identified uses for either slough.

Agricultural Supply (AGR)

Presently, both sloughs are used as a source of water for pasture irrigation and stock watering. Additionally, Mud Slough (north) is used for limited crop irrigation (Pierson et al., 1989a). In order to meet full attainment of AGR, the use of the sloughs for AGR require exclusion of subsurface drainage, because its elevated salinity and trace elements may restrict this use. The current hydrology of Grassland watershed requires that one of the sloughs must convey subsurface drainage at any given time; therefore, it is not presently possible to use both sloughs simultaneously for AGR.

Although, the sloughs are presently being used for agricultural water supply, this use is restricted due to elevated salinity and trace elements (selenium and boron) in the agricultural drainage. Removal of agricultural drainage would enhance agricultural water supply uses in Salt Slough but not in Mud Slough (north). In the absence of agricultural subsurface drainage discharges, Mud Slough (north) water quality is poor due to inherently elevated salinity, boron, and molybdenum concentrations (Vargas, et al., 1995). These levels of salinity and of boron restrict the use of Mud Slough (north) for crop irrigation to crops that are moderately tolerant of salinity and moderately tolerant of boron (Ayers and Westcot, 1985).

Due to naturally elevated salt and boron concentrations, identification of full agricultural use would not be appropriate for Mud Slough (north); therefore a subcategory of limited agricultural use was considered. Full agricultural use is not deemed attainable because imposition of effluent limits and cost effective and reasonable best management practices for nonpoint source control would not result in the attainment of the use (40 CFR 131.10(d)). Applying the limited agricultural use allows the continued use of the slough for agricultural uses that are not restricted by the inherent water quality limitations.

Based on the past and present agricultural uses, natural background water quality, and potential agricultural uses of the sloughs in the absence of drainage discharges, AGR is identified as a use of Salt Slough and limited AGR is identified for Mud Slough (north). Limited AGR in Mud Slough (north) is defined as uses of water for crops that are moderately tolerant to salinity and boron as defined in Ayers and Westcot (1985).

Water Contact (REC-1) and Non-Contact Recreation (REC-2)

Both types of recreational uses have occurred on Mud Slough (north) and Salt Slough, although some characteristics may deter some users. These characteristics include turbid waters, muddy stream bed, low flow conditions, and potential presence of vector and nuisance organisms. Incidental ingestion of water with selenium concentrations above the California Maximum Contaminant Level (MCL) but below the Federal MCL are not expected to cause a public health concern, due to the short period of such exposure.

No additional recreational benefits are expected to be achieved by restricting subsurface drainage discharges. While the water quality would improve by eliminating such discharge, the present recreational opportunities have developed as a result of the effluent-dominated flow characteristics of the sloughs. In the absence of these discharges, flow would be reduced and would affect the quality of recreational uses. Thus, there is no net benefit to recreational uses of the sloughs by eliminating this discharge.

Although there are no public access areas with accommodations for swimmers or bathers along either slough, local residents have been known to wade in both sloughs while scavenging for frogs and clams. This activity does represent contact recreation. Based on these evaluations both REC-1 and REC-2 uses are identified for Mud Slough (north) and Salt Slough.

Warm Freshwater Habitat (WARM)

The aquatic life beneficial use for the sloughs was inferred from an evaluation of fishery resources data, due to the unavailability of biological data on other organisms. A direct correlation between the type of fishery present (e.g. warm or cold) and the type of aquatic ecosystem supported was assumed. Water temperature data was also used in the evaluation.

The evaluation showed that Salt Slough has a diversity (number of species) of fish species similar to other locations observed throughout the San Joaquin Valley (Saiki, 1984). The association of fish in the slough was similar to other sites along the lower San Joaquin River. The fish in Salt Slough were observed to fluctuate in species composition and abundance from sampling to sampling, such that a species may disappear from the association while others not formerly present may become abundant. The sparse data for Mud Slough (north) also show similar trends in fish distribution. During low flow conditions in Mud Slough (north), however, species diversity and abundance may be limited to a few resistant species. The association of fish found in Mud Slough (north) and Salt Slough resemble the association of minnows described by Brown (unpublished data). This fish association is positively correlated with water quality parameters identified with agricultural discharges (elevated specific conductance, hardness, and nutrients). The most common fish species in the sloughs were fathead minnow (*Pimephales promelas*), common carp (*Cyprinus carpio*), inland silverside (*Menidia beryllina*), and Sacramento blackfish (*Pogonichtys macrolepidotus*). These fish species are associated with a warm water ecosystem.

It is not known if removal of agricultural discharges would result in an enhancement (greater biodiversity, greater abundance of native fish species, and biomass) of the aquatic beneficial uses of the sloughs. Removal of these discharges would remove a source of flow to the sloughs, since these are effluent-dominated water bodies. The resultant flow condition may negatively impact the aquatic resource. Additionally, there may not be a significant improvement in overall water quality, particularly in Mud Slough (north). Historic conditions (pre-subsurface drainage discharges) in Mud Slough (north) show seasonal low flow and high salinity and boron concentrations.

WARM beneficial use is identified for Mud Slough (north) and Salt Slough based on the presence of a warm water fishery.

Cold Freshwater Habitat (COLD)

Evaluation of current and historic temperature data show that temperature profiles for the sloughs have not been greatly affected by past modifications of basin hydrology (CVRWQCB, 1996). The temperature profiles are consistent with the description of San Joaquin Valley floor water bodies as warm, sluggish, meandering sloughs, oxbow lakes and backwaters (Moyle, 1976). The maximum temperature of 56.5 °F recommended by the National Marine Fisheries Service, between mid-April and the end of September for chinook salmon, a common cold water species native to the San Joaquin River is exceeded in both sloughs in all but the winter months (mid-November to mid February) (CVRWQCB, 1996 draft).

The association of fish reported for Mud Slough (north) and Salt Slough do not fall into the category of species generally associated with cold water fisheries (e.g. salmon, sturgeon). Migrating adult chinook salmon (*Oncorhynchus tshawytscha*) have been known to stray into Salt Slough and other non-origin streams due to improper imprinting of home streams or because of the lack of attractive flows in the east side San Joaquin River tributaries (CDFG, 1987). Straying is an aberration as neither slough has the required substrate for spawning or the required environment for development of eggs and young (SWRCB, 1987). Therefore, cold fresh water habitat uses are not currently being attained for Mud Slough (north) or Salt Slough.

The inability of Mud Slough (north) and Salt Slough to support a common California cold water species indicates that cold water habitat is not an existing or a potential use of Mud Slough (north) or Salt Slough nor has either slough supported such use. Thus, since COLD is not a current or past use and does not have the potential to be realized, it is not identified for the sloughs.

Migration of Aquatic Organisms (MIGR)

*Cold Water Species*

In California, the migratory fish species are principally steelhead and rainbow trout (*Oncorhynchus mykiss gairdneri*), white sturgeon (*Acipenser transmontanus*), American shad (*Alosa sapidissima)*, and chinook salmon. As noted earlier, chinook salmon are known to occasionally stray into Salt Slough, however, this is an aberration as evidenced by lack of appropriate habitat and environment for egg development (pre-spawning), spawning, juvenile development, and migration of smolts. The 54 °F maximum temperature required prior to and during seaward migration of smolts (DWR, 1988) is exceeded during the height of the emigration period (March to June). Additionally, there are no natural tributaries to Mud Slough (north) and Salt Slough that lead to areas suited for cold water spawning. Therefore, migration is not a beneficial use of Mud Slough (north) and Salt Slough for cold water and anadromous fish species.

*Warm Water Species*

Another species known to migrate to spawning sites is striped bass *(Morone saxatilis)*. Striped bass generally reside in estuaries and in sea water during a portion of their adult phase and migrate in the spring to large rivers to spawn. In the San Joaquin River, striped bass commonly spawn from Venice Island to Antioch (Moyle, 1976). Striped bass have been identified in Mud Slough (north) (Saiki, unpublished data), however, it is unlikely that their presence was due to migration. More likely they, entered Mud Slough (north) via the irrigation delivery channels that import water from the Delta.

Salt Slough and Mud Slough (north) do not provide the necessary habitat for successful spawning of striped bass. Successful spawning is dependent on the interaction of three factors: temperature, flow, and salinity. Striped bass generally prefer to spawn in large rivers that have optimum spawning flows. Sufficient flow is required to maintain eggs and larvae suspended but not so high that eggs are washed into quiet waters. Mud Slough (north) and Salt Slough, with their fluctuating flows, are not suitable habitat for such spawning. Additionally, the salinity level in the sloughs is too great to permit successful spawning. Because of the narrow tolerance of striped bass to these three factors, there are only two principal spawning areas in the Delta. These are the Sacramento River from Isleton to Butte City and the San Joaquin River and its sloughs from Venice Island to Antioch (Moyle, 1976). As a result, MIGR is not an identified beneficial use for either slough.

Spawning, Reproduction, and/or Early Development (SPWN)

*Cold Water Species*

Mud Slough (north) and Salt Slough present an environment unfavorable for spawning of cold water species. As was previously noted, water temperatures in the sloughs are greater than the 56.5 °F most of the year except for the winter season. Temperatures exposures of adult chinook salmon and eggs above this threshold will result in greater than normal losses and abnormalities of young fish. These temperatures are exceeded in the sloughs during the adult immigration period (mid-July through November) (DWR, 1988). Water temperatures from 55 to 57.5 °F, though producing low egg mortality, results in sac-fry mortalities greater than 50% (DWR, 1988). These temperatures are exceeded in the sloughs during a portion of the incubation period.

In addition to the temperature restrictions on reproduction and early development, the sloughs do not possess the appropriate substrate required by many cold water species for spawning. The sloughs generally contain fine sediments rather than the gravel beds required for spawning. The beneficial use of cold water spawning is not identified for either Mud Slough (north) or Salt Slough because of the conditions for spawning, reproduction and early young rearing are not present.

*Warm Water Species*

Mud Slough (north) and Salt Slough have been identified as a warm water habitat due to the presence of a variety of warm water fish species. Water temperatures and substrate, in Mud Slough (north) and Salt Slough are, generally suitable for spawning of many warm water species present in the Grassland watershed (USEPA, 1972), therefore the warm water SPWN beneficial use is an existing and identified beneficial use of the sloughs.

Wildlife Habitat (WILD)

Wildlife habitat beneficial use is a use of water to support either wetland or terrestrial wildlife habitat. Presently, wetlands in the Grassland watershed are artificially maintained as seasonal fresh water wetlands, permanent alkali marshes, and grassland. These wetlands are important habitat for migratory waterfowl. Prior to 1985, Salt Slough was a source of water for maintenance of these wetlands. Since 1985, selenium laden subsurface drainage flows from the Drainage Problem Area have not been used for wetland water supply in the Grassland watershed. The result has been that these drainage flows have been diverted away from the wetlands causing an increase in direct discharge of these flows to Mud Slough (north) and Salt Slough. The sloughs are now used as the principal conveyance of subsurface drainage to the San Joaquin River. Salt Slough continues to be used on rare occasions for wetland water supplies for the San Luis National Wildlife Refuge. This use requires diverting subsurface drainage out of Salt Slough. Because the wildlife habitat beneficial use is a past use of the sloughs, the wildlife habitat beneficial use (WILD) is identified for both sloughs.

Commercial and Sports Fishing (COMM)

Sport fishing is a present and past use of both Mud Slough (north) and Salt Slough, although this use is only practiced to a limited extent due to the inaccessibility of the sloughs to the public. The quality of this use may be limited in Mud Slough (north) due to intermittent and low flow conditions, however, it does not preclude the attainment of this use. Based on this observation, the sport fishing beneficial use (COMM) is proposed for both Mud Slough (north) and Salt Slough.

Shellfish Harvesting (SHELL)

Collection of shellfish is practiced to a limited extent by local residents on Mud Slough (north) and Salt Slough. This use is limited by the inaccessibility of both sloughs to the public and characteristics of both sloughs that may detract this practice. These include turbid waters, muddy stream bed, low flow conditions, and potential presence of vector and nuisance organisms. Despite these factors, a Shellfish Harvesting (SHELL) beneficial use is identified for both Mud Slough (north) and Salt Slough.

Preservation of Biological Habitats of Special Significance (BIOL)

The San Luis National Wildlife Refuge has riparian water rights to Salt Slough. These rights are exercised only on a limited basis due to poor water quality in Salt Slough. Salt Slough has been used occasionally during drought periods to supply summer irrigations to this refuge when it carries operational spills and agricultural surface drainage of adequate quality for wetland use. There is no record that Mud Slough (north) has been utilized to supply any of the wildlife refuges or management areas with water, including Kesterson National Wildlife Refuge, which it traverses. Kesterson National Wildlife Refuge is currently supplied by the Santa Fe Canal and San Luis Canal. It is unlikely that Mud Slough (north) will supply Kesterson National Wildlife Refuge with water since there is already a water supply system, and because of intermittent low flow and poor quality conditions in Mud Slough (north).

The beneficial use of preservation of biological habitats of special significance (BIOL) is identified for Salt Slough based on the existence of this use. This use is, however, not identified for Mud Slough (north) based on the absence of past, present or potential use. This use may be re-evaluated for Mud Slough (north) based on evolving land use and water management in the region.

**Grassland Wetland Channels**

All of the wetland supply channels identified in Appendix 1 were considered together, because of the similarity between these water bodies and their uses. Table 2 summarizes the beneficial uses identified for the wetland channels.

Assessment of beneficial uses requires evaluation of past, present, and potential uses of the water body. Development of most of the water conveyance infrastructure pre-dates the formation of the Grassland Water District (GWD) in 1953. (The GWD was formed to manage a 50,000 acre-feet water supply granted for the wetlands and is the largest entity for management of wetlands within the Grassland watershed.) Because most of the infrastructure was in place prior to the formation of the GWD, there is little historic information on the wetland channels. However, these channels were constructed or re-constructed and historically used for the same purpose for which they are used presently. This continuity is evidenced by the stability of land use practices in the GWD. The total wetland area in the GWD has remained stable since 1957 at approximately 47,000 acres (SJVDP, 1990b). Thus, it is reasonable to assume that the past uses of these channels are the same as the present.

Municipal and Domestic Supply (MUN)

Wetland supply channels identified in Appendix 1 were constructed or re-constructed for the purpose of conveying one or more of the following types of flows: agricultural water supplies, wetland water supplies, agricultural drainage and/or wetland drainage. Additionally, some of these channels also convey storm water from the city of Los Banos. The agricultural and wetland drainage flows contain elevated salinity levels that often exceed Federal and State standards for drinking water. Additionally, these flows may contain pesticides and other contaminants of concern to public health, due to their agricultural origins, and are not likely to be approved for drinking water supply by the Department of Health. According to the SWRCB Sources of Drinking Water Policy (Resolution 88-63), water systems designed or modified for the purpose of conveying storm water or agricultural drainage are exempt from municipal and domestic supply. Thus, municipal and domestic supply (MUN) is not a present or past use of the wetland channels identified in Appendix 1.

Conveyance of agricultural drainage may be eliminated in the future from the wetland channels as a result of this proposed basin plan amendment. It is anticipated that they will continue to convey wetland water supply, wetland drainage and stormwater. Salinity of 3,000 mg/L total dissolved solids (TDS) established for municipal and domestic supplies in the SWRCB Sources of Drinking Water Policy may be exceeded during periods of wetland drainage. A study has demonstrated a 5-7 fold increase in concentration of TDS of wetland drainage from the concentration of the applied water (USBR, 1991a). Thus, based on water quality, municipal and domestic supply is not expected to be a potential use. Municipal and domestic supply is not a past, present, or potential use of the wetland channels and is thus, not an identified use for channels listed in Appendix 1.

Industrial Service (IND) and Industrial Process Supply (PROC)

None of the wetland channels are utilized for these uses and there is no record that they have been utilized for these purposes, as there are no industrial facilities adjacent to the channels. The land that borders these channels is either agricultural or wetland. Water quality conditions, such as high turbidity, salinity, and alkalinity may restrict industrial uses requiring certain water quality. The irregular nature of flow in the secondary and tertiary channels makes this an unreliable source. Due to the irregular supply of water in the wetland channels and the fluctuating water quality, with or without discharges, these uses are not likely to be realized. Thus, since IND and PROC uses are not current or past uses and do not have the potential to be realized, they are not identified for the wetland channels.

Agricultural Supply (AGR)

Presently, the wetland channels are used as a source of water for pasture irrigation and/or stock watering. Many of the wetlands served by these channels are used for seasonal wetlands, which are drained in the spring and then managed as natural pastures for livestock feed and wildlife habitat.

Since flow in the channels is artificial, there may be periods of dryness in some of the channels. Under the present water management regime (conveyance of agricultural drainage), water quality may also limit the use to crops that are tolerant of elevated salinity and trace element concentrations, primarily boron and selenium.

It is anticipated that in the future, the wetland channels will no longer convey agricultural drainage. However, they will continue to convey wetland water supplies and wetland drainage. The wetland water supply is of relatively good quality and will not result in any restriction for AGR uses aside from intermittent flows. The wetland drainage, however, contains elevated boron and salinity and will restrict the uses of this water to crops that are very tolerant of boron and moderately tolerant of salinity. Concentrations of boron have measured as high as 6.2 mg/L in wetland drainage (Grober and Karkoski, 1995). According to irrigation guidelines, water with boron concentrations in excess of 6 mg/L are only suitable for crops very tolerant to boron (Ayers and Westcot, 1985).

The wetland channels do not have natural flow component as they were primarily constructed to transport water supplies for the management of the wetlands. Many of the present managed wetlands of the Grassland watershed are on the basin rim physiographic zone. Soils of this zone are characterized by elevated salinity and boron concentrations. Elevated salinity and boron in the wetland drainage result from mobilization of soluble salts and boron of the wetland soils. Identification of unrestricted agricultural use for the wetland channels would preclude the use of the channels for wetland drainage and interfere with the management of the wetlands. Therefore, as with Mud Slough (north), limited agriculture use was considered as an alternative to identifying unrestricted agricultural use.

At present there are no available best management practices to reduce the levels of salts and boron resulting from wetland management in areas with naturally elevated concentrations of these constituents. Thus unrestricted agricultural uses are not deemed attainable because imposition of cost effective and reasonable best management practices for nonpoint source control would not result in the full attainment of the use (40 CFR 131.10(d)). Applying the limited agricultural use allows the continued use of the slough for agricultural uses that are not limited by inherent water quality limitations.

Due to the natural geohydrology of the region, limited AGR beneficial uses are identified for the wetland channels during periods of wetland discharges for the irrigation of crops that are very tolerant of boron.

Water Contact (REC-1) and Non-Contact Recreation (REC-2)

REC-1 and REC-2 are not present or past uses of the wetland channels. These channels are on private property and are not accessible for public use. Furthermore, the channels were designed for the purpose of conveying water and do not have characteristics suitable for REC-1. The channels have steep banks and many of the channels are too small and flow too shallow for REC-1. Additionally, channel vegetation and the potential presence of vector organisms may deter some users.

Based on this evaluation, REC-1 and REC-2 are not identified for any of the wetland channels.

Shellfish Harvesting (SHELL)

This use is limited by the inaccessibility of many of the wetland channels to the public and potential presence of vector and nuisance organisms. In addition, characteristics of the channels would seriously limit the development of a viable shellfish environment. Those characteristics include turbid waters, muddy stream beds, low flow conditions, and intermittent dryness of the channels. Because of these limitations, the development of a viable shellfish community is unlikely and thus, the shellfish harvesting (SHELL) beneficial use is not an identified use for the wetland channels.

Warm Freshwater Habitat (WARM)

Water supplies for the Grassland watershed wetlands are derived from the Sacramento-San Joaquin Delta through the Delta-Mendota Canal, and are then distributed to wetlands through a network of constructed and re-constructed channels. Fish residing in the Delta have been known to be transported to Grassland watershed channels through the Delta-Mendota Canal (CVRWQCB, 1996 draft). The types of fish species that are generally transported through the Delta-Mendota Canal are associated with warm aquatic environments (e.g. striped bass, channel catfish). The Delta-Mendota Canal itself is classified for WARM beneficial uses in the Basin Plan (CVRWQCB, 1995d). The fish species commonly observed in the larger wetland channels are striped bass, channel catfish (*Ictalurus punctatus*), large mouth bass (*Micropterus salmoides*), and carp (Tim Poole, personal communications). These species are associated with warm water aquatic environments.

The habitat of the wetland channels, however, is not conducive to long-term residence, including rearing and propagation of fish species. The constructed and re-constructed wetland channels do not possess natural features, such as pools, riffles, aquatic vegetation, etc., which form important fish habitat for the various life stages. Furthermore, the channels are subject to frequent periods of dryness or very low flow.

It would not be appropriate to designate unrestricted warm freshwater habitat because the lack of appropriate habitat and fluctuating water levels in the wetland channels would not support preservation and enhancement of aquatic life through rearing of young and propagation. The wetland channels are merely capable of temporarily sustaining aquatic life. An alternative to identifying full warm freshwater habitat is the identification of limited warm freshwater habitat. Identification of a limited warm freshwater aquatic life permits the maximum aquatic life use inherent in wetland channels.

Thus, only a limited WARM use is identified for wetland channels; where "limited" is defined as temporarily sustaining warm water aquatic species but not preserving or enhancing them through rearing or propagation.

Cold Freshwater Habitat (COLD)

Water temperature data is not available for wetland channels. However, water bodies of the San Joaquin Valley floor are generally associated with warm aquatic habitats. This association is due to the warm summers and mild winters of the San Joaquin Valley. Water temperatures for Mud Slough (north) and Salt Slough were found to be correlated with air temperature and season (CVRWQCB, 1996 draft). This type of correlation is also expected for the wetland channels. Additionally, the wetland channels may be highly sensitive to air temperature and solar radiation due to the lack of riparian vegetation which shades streams and ameliorates the effects of solar radiation on water temperature.

The fish species generally found in the wetland channels are not associated with cold water environments. Because of warm water temperature and the absence of fish species associated with cold water environments, the COLD use is not identified for the wetland channels.

Migration of Aquatic Organisms (MIGR)

In California, the migratory fish species are principally steelhead, rainbow trout, white sturgeon, American shad, and chinook salmon. These species are generally not found in the wetland channels. They are also associated with cold water environments. Because of the warm water environment of the wetland channels, the migration of these species through these channels would not be supported (see discussion for Mud Slough (north) and Salt Slough). Additionally, there are no tributaries to these channels that are appropriate spawning areas.

Striped bass are also known to migrate to spawning sites. As was noted in the discussion for Mud Slough (north) and Salt Slough, the Grassland wetland channels do not provide the appropriate environment for the spawning of this species and their presence in the wetland channels is due to straying into the Delta-Mendota Canal rather than migration. As a result, MIGR is not an identified beneficial use for wetland channels.

Spawning, Reproduction, and/or Early Development (SPWN)

*Cold Water Species*

The wetland channels present an environment unfavorable for SPWN of cold water species. First, temperatures are unfavorable for all activities of cold water species. Second, the substrate in the channels is inappropriate for spawning of cold water species, which require gravel beds.

*Warm Water Species*

The environment in the wetland channels is also inappropriate for spawning of warm water species. The habitat created by constructed or re-constructed channels is unsuitable for the long-term residence of fish species. The channels are straight with steep banks and scarce aquatic vegetation. Aquatic life generally requires diverse habitats to complete their life cycles. For example, juveniles may seek refuge from predatory fish in shallow stream banks having rooted vegetation, while adult fish may reside in deeper water. Based on this analysis, the SPAWN beneficial use is not identified for the wetland channels.

Wildlife Habitat (WILD)

The wetland channels were historically and to this day are used in-part to convey water supplies to the wetlands. This function is likely to continue in the future due to policies to preserve wetlands. Some of the channels are also presently used to convey agricultural subsurface drainage. The use of these channels for WILD may be restricted when the channels are used for agricultural drainage conveyance, due to elevated selenium concentrations. Nevertheless, WILD is a past, present, and probable future use and as such is an identified use of the wetland channels identified in Appendix 1.

Preservation of Biological Habitats of Special Significance (BIOL)

The Grassland watershed contains the largest continuous wetland area in California (SJVDP, 1990b). This wetland area is composed of private and public wetlands, both of which are managed wetlands that are supplied by water from outside the watershed. Numerous wetland channels supply public refuges or wildlife management areas with wetland water supplies (CVRWQCB, 1996 draft). The distribution of water is done through a complicated array of sloughs, canals and drains. Boundary Drain and the San Luis Canal supply the Los Banos Wildlife Management Area. The San Luis Wasteway supplies the Volta Wildlife Management Area. Eagle Ditch, Santa Fe Canal and the San Luis Canal supply the Kesterson National Wildlife Refuge. Canals within the San Luis Canal Company, a private irrigation company, supply water to the San Luis National Wildlife Refuge. There are numerous canals, drains and sloughs that will also supply the new wildlife management areas in the future.

Most private wetland areas are not managed as wildlife refuges but as hunting clubs. They are, however, closely connected to the public refuges and wildlife management areas because most birds will use both areas. Additionally, the interconnected water supply channels serve both the public and private areas and act as one supply network. Because of this interconnection and the importance of the private wetlands in the Grassland watershed, the beneficial use of Preservation of Biological Habitats of Special Significance (BIOL) is identified for the wetland water supply channels (listed in Appendix 1) within the wetland areas.

# PART IV WATER QUALITY OBJECTIVES

Water quality objectives are established in basin plans by the Regional Board to reasonably protect beneficial uses. Water quality objectives provide a specific basis for the measurement and maintenance of water quality.

The San Joaquin River Basin Plan contains water quality objectives for the surface water bodies of concern to this effort. Some are specific to the control of the major constituents of concern in agricultural subsurface drainage. In this proposed Basin Plan Amendment, revisions to selenium water quality objectives are being considered. The revision or addition of water quality objectives for other constituents may be needed in the future as a basis for the regulation of agricultural subsurface drainage discharges.

## ALTERNATIVES CONSIDERED

Four alternatives were considered in developing amendments to the water quality objectives for the regulation of agricultural subsurface drainage discharges: 1) no action; 2) the adoption of U.S. EPA promulgated selenium water quality criteria; 3) adoption of site specific selenium water quality objectives; and 4) expanding the use of selenium water quality objectives previously adopted and approved for wetland water supply. The criteria used for selecting the recommended alternative include: 1) consistency with state and federal laws and policies; and 2) whether beneficial uses are protected. The four alternatives are evaluated below.

Alternative 1 - No Action

The U.S. EPA promulgated selenium water quality standards for the San Joaquin River, Mud Slough (north), and Salt Slough in December 1992. These standards effectively replaced all Regional Board adopted selenium water quality objectives except for a 12 $\mu$g/L instantaneous maximum in the San Joaquin River downstream of the Merced River and a 2 $\mu$g/L monthly mean objective for wetland water supplies. The U.S. EPA standards have not been adopted by the Regional Board, so they would need to be evaluated on a case by case basis for use in waste discharge requirements although they do apply to NPDES permits which are subject to federal standards.

The lack of numeric selenium water quality objectives for the sloughs and San Joaquin River limits the Regional Board to the use of narrative water quality objectives as a basis for taking actions to protect beneficial uses which are impacted by selenium in agricultural subsurface drainage.

The current 2 $\mu$g/L wetland water supply objective restricts the use of water supplies rather than protecting the channels used to convey the supply since it only applies to the water when it is used in the wetland and not to the entire water body supplying the water. This objective effectively places the burden on wetland managers to avoid using water which would impact waterfowl and other wildlife beneficial uses, rather than placing the burden on the dischargers to protect designated beneficial uses. When wetland water supplies were limited, wetland managers were able to manage the conveyance system in a manner that avoided commingling of drainage and wetland supplies. Currently, wetland managers can not make optimal use of expanded (53,500 acre-ft/yr firm supply expanded to a maximum of 180,000 acre-ft/yr) wetland supplies provided by CVPIA due to the physical limitations of the shared wetland supply/subsurface drainage conveyance system and the elevated selenium concentrations in the subsurface drainage.

<u>Alternative 2 - Adopt U.S. EPA Promulgated Selenium Water Quality Criteria (5 μg/L 4-day average and 20 μg/L maximum) for the San Joaquin River, Mud Slough (north), and Salt Slough</u>

The U.S. EPA had previously approved the Regional Board's 5 μg/L monthly mean water quality objective for the San Joaquin River downstream of the Merced River during the 1988 amendment process. In 1992, the U.S. EPA promulgated new objectives for Mud Slough (north), Salt Slough, and the San Joaquin River (5 μg/L, 4-day average standard). Recent reviews of the scientific literature indicate that a 5 μg/L, 4-day average objective is the maximum chronic objective that is still protective of aquatic life (USEPA, 1987).

<u>Alternative 3 - Adopt Site Specific Selenium Water Quality Objectives for the San Joaquin River, Mud Slough (north) and Salt Slough</u>

Numerous comments were received during the workshops regarding developing site specific objectives for selenium. Comments were received that argued for both a less stringent selenium water quality objective than the U.S. EPA criteria and one which considered the sulfate levels in the San Joaquin River system as well as a more stringent objective than the U.S. EPA criteria. With respect to considering sulfate concentrations, staff concluded that the available data is inconclusive as to the ameliorative effects of sulfate to selenium toxicity. Additionally, the data does not presently point to a specific selenium objective. Thus, based on the inconclusive and insufficient nature of the data, a less stringent selenium objective than the U.S. EPA water quality criteria is not justified at the present time.

With respect to a more stringent selenium water quality objective, the scientific literature of Maier and Knight (1990) was cited in support. However, with the exception of waterfowl, a convincing body of evidence has not been develop to support an objective more stringent than the present U.S. EPA aquatic life criteria. Ecological risk assessment data was presented from the State Water Resources Control Board Modified Ocean Plan Method. These findings were not considered as reliable as the U.S. EPA criteria that was based primarily on field observations of impacts to aquatic life.

<u>Alternative 4 - Expand the Use of Previously Adopted and Approved Selenium Water Quality Objectives for Wetland Water Supplies (2 μg/L monthly mean) to all Water Bodies (Including Salt Slough) Which Transport Wetland Water Supplies</u>

In 1988, the Regional Board adopted a 2 μg/L monthly mean selenium water quality objective for any water supplies used for waterfowl habitat in the Grassland Water District, San Luis National Wildlife Refuge, and Los Banos State Wildlife Area. The objective was placed on the water supply rather than the water body to recognize the unique hydrology of the Grasslands where use of the joint use water bodies alternates between transport of wetland water supply and transport of agricultural drainage. Increased water supply for wetland habitat has made the continued use of the water bodies in this manner impractical.

Selenium is unique from other toxicants in that bioaccumulation through the food chain and cycling through the aquatic system are the primary causes of impacts to higher trophic levels of aquatic ecosystems. Thus, flowing systems which are subject to flushing of suspended matter and bottom sediments are expected to behave differently from ponded systems such as wetlands. With respect to wetland water supplies of the Grassland watershed, the Regional Board evaluated data developed in evaporation pond studies by the U.S. Fish and Wildlife Service. Studies in evaporation ponds have shown impaired hatchability of aquatic bird eggs and susceptibility to disease at certain selenium body thresholds. These thresholds have been correlated with selenium water borne concentrations of 2.3 to 2.6 $\mu$g/L (Skorupa and Ohlendorf, 1991 and Skorupa personal communications).

To fully protect waterfowl, a 2 $\mu$g/L monthly mean water quality objective should be adopted for wetland water supply channels, including Salt Slough, rather than on water actually used in wetland management to move compliance to specific water bodies rather than at the point of use within numerous wetland areas. If objectives are not adopted for the wetland channels, wetland managers will be faced with the choice of forgoing available supplies or contaminating their wetlands. If objectives greater than those proposed are adopted, some degree of impairment may occur in wetland habitat receiving the water.

Recommended Alternative

The Regional Board should adopt new selenium water quality objectives which will fully protect beneficial uses in the Grassland watershed and San Joaquin River. Currently, U.S. EPA promulgated criteria has limited applicability, while adoption in a Basin Plan would result in a clear standard. For the water bodies in question, uses which are most sensitive to selenium include aquatic life or the wetland supply component of wildlife. Therefore, the recommended alternative is using a combination of Alternatives 2 and 4 to develop selenium water quality objectives for the San Joaquin River, Mud Slough (north), Salt Slough, and Wetland Water Supply Channels. This action satisfies both selection criteria since the action 1) will allow the Regional Board to formulate a program of implementation as is consistent with state and federal laws and policies and 2) will lead to protection of those beneficial uses which are currently impaired by elevated levels of selenium.

Adoption of the U.S. EPA aquatic life criteria (5 $\mu$g/L, 4-day average) for selenium is recommended for protection of aquatic life in the San Joaquin River downstream of Sack Dam and Mud Slough (north), while adoption of a 2 $\mu$g/L monthly mean selenium water quality objective is recommended for wetland water supply channels including Salt Slough.

**Revisions to Water Quality Objectives**

Development of water quality objectives requires, at a minimum, consideration of the following elements (Porter-Cologne Water Quality Control Act, Chapter 4, Article 3, Section 13241):

a) beneficial uses;

b) environmental characteristics of the hydrographic unit;

c) water quality conditions that could be reasonably achieved;

d) economic considerations;

e) the need for housing; and

f) the need to develop and use recycled water.

A discussion of the current proposal is given below. The proposed selenium WQOs are outlined in Table 3. No other changes in water quality objectives are proposed at this time.

The two beneficial uses most sensitive to elevated selenium concentrations are Aquatic Life and the wetland supply component of the Wildlife designation. Since both these uses have been proposed for water bodies in the Grassland Watershed, appropriate water quality objectives are evaluated below.

## SELENIUM OBJECTIVE FOR SALT SLOUGH AND SELECTED WETLANDS SUPPLY CHANNELS

A numeric water quality objective for selenium is proposed for protection of wetland water supply channels in the Grassland watershed. It is proposed to adopt a selenium objective of 2 $\mu$g/L as a monthly mean, for Salt Slough and the water supply channels identified in Appendix 1. The maximum selenium objective promulgated by USEPA in 1992 for Salt Slough (20 $\mu$g/L) is also proposed for adoption. Consideration of the six elements required by Porter-Cologne to adopt these objective follows below. Previously monthly mean objective only applied to the water supplies that were actually used in wetland management, rather than to the water body.

Table 3. Proposed Selenium Water Quality Objectives for the San Joaquin River, Mud Slough (north), Salt Slough, and Wetland Water Supply Channels Identified in Appendix 1

| Location | Selenium Concentration ($\mu$g/L) | |
|---|---|---|
| | average | maximum |
| San Joaquin River, mouth of Merced River to Vernalis | 5 (4-day average) | 12 |
| Mud Slough (north) and San Joaquin River from Sack Dam to the mouth of the Merced River | 5 (4-day average) | 20 |
| Salt Slough and wetland water supply channels in the Grassland watershed listed in Appendix 1 | 2 (monthly mean) | 20 |

Beneficial Uses

Beneficial uses considered in developing the recommended water quality objective are those proposed in Table 1 for Salt Slough and the wetland supply channels. The most sensitive of these uses to selenium is the waterfowl component of the wildlife beneficial use. Factors considered to protect this use are:

- the objective is consistent with the guidelines of Federal and State Wildlife agencies (Lemly and Smith, 1987);
- evidence continues to suggest that the selenium level for protection of waterfowl habitat is lower than the U.S. EPA aquatic life water quality criteria (Skorupa and Ohlendorf, 1991; Maier and Knight, 1990);
- the Grassland watershed contains a primary waterfowl habitat;
- the objective is consistent with the needs for waterfowl protection as outlined in the San Joaquin Valley Drainage Program Final Report; and
- with an expanded wetland water supply, the channels become an integral part of wetland management.

A more extensive discussion of beneficial uses is presented in Part III of this report.

Environmental Characteristics of the Hydrographic Unit

The environmental characteristics of the hydrographic unit are discussed extensively in Part III of this report.

Water Quality Conditions That Could Be Reasonably Achieved

Water quality data collected by the Regional Board and other agencies suggests that the proposed selenium water quality objectives in the Grassland watershed (wetland supply channels, Mud Slough (north), and Salt Slough) can only be met by removing the subsurface drainage from those channels. The San Joaquin Valley Drainage Program Final Report (SJVDP, 1990a) suggested that a wetland bypass be constructed to convey drainage to the San Joaquin River downstream of the Merced River. Construction of the wetland bypass would lead to protection of beneficial uses in the Grassland watershed. Districts in the Drainage Problem Area are currently pursuing the first phase of construction of the bypass which would remove subsurface drainage from Grassland watershed channels and allowing proposed objectives to be met.

Economic Considerations

A discussion of economic considerations is included in Part V in the section entitled "Estimated Costs and Potential Funding Sources". The high cost of the extension was a major consideration in the establishment of the extended compliance time schedule discussed in the implementation section.

Need for Housing

The proposed water quality objective should not impact the need for housing in the Grassland watershed.

Need to Develop and Use Recycled Water

One option to minimize the size of the wetland bypass is the recirculation of drainage water to reduce drainage volumes. The proposed water quality objective is, therefore, consistent with the need to develop and use recycled water.

## SELENIUM OBJECTIVE FOR THE SAN JOAQUIN RIVER FROM SACK DAM TO VERNALIS AND MUD SLOUGH (NORTH)

In 1988, the Regional Board adopted a selenium water quality objective of 5 $\mu$g/L as a monthly mean for the San Joaquin River downstream of the Merced River inflow with a critical year relaxation to 8 $\mu$g/L. A 12 $\mu$g/L maximum objective was also adopted. In 1989, the 5 $\mu$g/L monthly mean and 12$\mu$g/L maximum water quality objectives were approved by the State Water Board and the U.S. EPA. The U.S. EPA disapproved the critical year relaxation of the chronic objective. In December 1992, the U.S. EPA promulgated a selenium water quality criteria of 5 $\mu$g/L as a 4-day average, for the San Joaquin River downstream of Sack Dam, Mud Slough (north) and Salt Slough. The U.S. EPA also promulgated a 20 $\mu$g/L selenium maximum objective for Mud Slough (north), Salt Slough, and the San Joaquin River from Sack Dam to the mouth of the Merced River. This promulgation superseded the previously approved 5 $\mu$g/L monthly mean water quality objective, but did not change the 12 $\mu$g/L instantaneous maximum on the San Joaquin River downstream of the Merced River.

The U.S. EPA action left the Regional Board without a clear standard for protecting beneficial uses. The state's objectives apply to management of nonpoint source discharges including those from subsurface drainage while EPA's promulgated standard can be enforced on point source discharges under federal NPDES permits. In order to provide a clear standard for the protection of beneficial uses, it is proposed that a water quality objective for selenium of 5 $\mu$g/L as a 4-day average be adopted for the San Joaquin River from Sack Dam to Vernalis and for the entire reach of Mud Slough (north). The U.S. EPA promulgated maximum criteria of 20 $\mu$g/L would also be adopted for Mud Slough (north) and the San Joaquin River from Sack Dam to the mouth of the Merced River. No change for the application of the current instantaneous maximum in the San Joaquin River from the mouth of the Merced River to Vernalis is proposed. The objectives would apply to all water year types.

Beneficial Uses

Beneficial use factors considered in assessing the recommended water quality objective were:

- the proposed objective is in agreement with the fresh water aquatic life chronic criteria promulgated by U.S. EPA;

- the proposed objective is consistent with recent scientific reviews that indicate a 5 µg/L objective is the maximum chronic objective that is still protective of aquatic life (USEPA, 1987); and

- the proposed objective is consistent with recommendations of the U.S. Fish & Wildlife Service as the maximum chronic objective that is still protective of aquatic life (Consensus, 1995).

A more extensive discussion of beneficial uses is presented in Part III of this report.

Water Quality Conditions That Could Be Reasonably Achieved

Previous staff reports (Chilcott, et al. 1995, and Figure 2) concluded that water quality improves in response to selenium load reductions in the San Joaquin River downstream of the Merced River. The San Joaquin Valley Drainage Program Final Report (SJVDP, 1990a) suggested a number of control actions that would lead to load reductions. Many of these control actions, along with others such as treatment, are in the research or development phase. A detailed staff evaluation of implementation of alternatives is presented in Appendix 2. This evaluation demonstrates that the load reductions necessary to meet water quality objectives can be reasonably achieved by a proposed combination of control actions which is presented in Part V of this report.

Environmental Characteristics of the Hydrographic Unit

The environmental characteristics of the hydrographic unit are discussed extensively in Part III of this report.

Economic Considerations

A discussion of economic considerations is included in Part V in the section entitled "Estimated Costs and Potential Funding Sources". It should also be noted that the cost of reducing loads to the degree required was a major consideration in the development of the extended compliance schedule discussed in the implementation section.

Need for Housing

The proposed water quality objectives should not impact the need for housing in the Grassland watershed.

Need to Develop and Use Recycled Water

One potential control action to reduce selenium loads is to recycle the subsurface drainage water. The proposed water quality objectives are, therefore, consistent with the need to develop and use recycled water.

**SUMMARY**

In summary, staff proposes that a 2 $\mu$g/L monthly mean and 20 $\mu$g/L maximum selenium water quality objective be adopted for Salt Slough and the Wetland Channels listed in Appendix 1. Staff also proposes that a 5 $\mu$g/L 4-day average selenium objective be adopted for Mud Slough (north) and the San Joaquin River from Sack Dam to Vernalis.

The 20 $\mu$g/L instantaneous maximum promulgated by USEPA for Mud Slough (north) and the San Joaquin River from Sack Dam to the mouth of the Mercer River is also proposed for adoption. The 12 $\mu$g/L instantaneous maximum already adopted by the Regional Board and approved by the State Board and USEPA, for the San Joaquin River from the mouth of the Merced River to Vernalis, will remain unchanged.

# PART V PROGRAM OF IMPLEMENTATION

Water Code Section 13242 prescribes the necessary contents of a program of implementation, which includes: 1) a description of the nature of the actions which are necessary to achieve the water quality objectives, 2) a time schedule, and 3) a monitoring and surveillance program. In addition, Water Code Section 13141 requires that prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program and identification of sources of funding be indicated in the Basin Plan. The beginning of this section presents an evaluation of alternative programs of implementation. This evaluation is followed by discussion of the proposed program of implementation based on the recommended alternative. The discussion reviews proposed amendments to Basin Plan policies, prohibitions, control actions, and compliance time schedules consistent with the recommended alternative. The estimated program cost is discussed later in this Section under "Estimated Costs and Potential Funding Sources."

## ALTERNATIVES CONSIDERED

The proposed water quality objectives for selenium in the San Joaquin River, Salt Slough, Mud Slough (north) and wetland water supply channels are being exceeded. The Board must develop a program of implementation to bring these water bodies into compliance with the proposed objectives in order to protect beneficial uses.

Five alternatives were considered to guide the Regional Board's program of implementation for achieving the selenium water quality objectives. These alternatives have varying levels of regulatory intervention (from regulatory encouragement of BMPs to effluent limits and discharge prohibitions). The alternatives also consider various maximum allowable time periods for compliance with water quality objectives (from immediate compliance to up to 25 years for certain water bodies).

The five alternatives are: 1) an immediate prohibition of discharge of agricultural subsurface drainage from the Drainage Problem Area (by October 1, 1996); 2) a phased approach to meeting water quality objectives using effluent limits and a long compliance time schedule (maximum 25 years); 3) a phased approach to meeting water quality objectives using effluent limits and a shorter compliance time schedule (maximum 15 years); 4) a phased approach to meeting water quality objectives using effluent limits and a 7 year compliance time schedule; and 5) a phased approach to meeting water quality objectives using regulatory based encouragement of Best Management Practices (BMPs) and a (maximum) 15 year compliance time schedule. Since adoption of water quality objectives without a program of implementation is not consistent with Porter-Cologne (Water Code Section 13242), the no action alternative for the implementation program was not considered.

Each alternative addresses three classes of water bodies: i) wetlands and Salt Slough; ii) San Joaquin River upstream of the Merced River and Mud Slough (north); iii) San Joaquin River downstream of the Merced River. The recommended approach for each class of water body is based on analysis of water quality data collected by the Regional Board and other agencies. This analysis indicates that selenium levels in the wetland supply channels, Salt Slough, Mud Slough (north), and the San Joaquin River from Sack Dam to the Merced River generally remain elevated in the presence of untreated subsurface drainage water. Reductions in selenium load in these water bodies may not lead to significant improvements in water quality due to the lack of assimilative capacity. The recommended approach in these water bodies is to remove the subsurface drainage water originating from the Drainage Problem Area, unless water quality objectives can be met through treatment.

Historical data also indicates that selenium load reductions lead to improvements in water quality in the San Joaquin River downstream of the Merced River. In water year 1992, selenium loads from the Grassland watershed were at the lowest level in the period of record with a flow weighted selenium concentration of 4.5 $\mu$g/L in the San Joaquin River at Crows Landing. In both water years 1989 and 1994 selenium loads discharged from the Grassland watershed were more than two times greater than the selenium load discharged in water year 1992. In those water years, the flow weighted selenium concentrations in the San Joaquin River at Crows Landing were 7.3 and 5.6 $\mu$g/L, respectively (Chilcott, et al., 1995). The elevated selenium concentrations recorded during water years 1989 and 1994 indicate that the proposed water quality objectives (5 $\mu$g/L, 4 day average) are likely being exceeded and beneficial uses impacted. If the proposed selenium water quality objectives are adopted, the Regional Board must adopt an implementation program for achieving compliance. Since historical data indicates that water quality in the San Joaquin River downstream of the Merced improves in response to load reductions, the alternatives focus on reducing selenium loads to meet selenium objectives in this water body.

The compliance schedules developed for alternatives 2-5 are based on prioritizing the water bodies based on the expected environmental benefit and the sensitivity of the beneficial use that is impacted. The most sensitive beneficial use is the wetland component of the wildlife beneficial use in the wetland supply channels and Salt Slough. As discussed in the beneficial use and water quality objectives sections, low levels of selenium (greater than 2 µg/L) may be detrimental to waterfowl. Since the wetland water supply channels are also used to convey subsurface drainage, top priority is given to removing the subsurface drainage from these channels. Compliance with the selenium water quality objective for Salt Slough and constructed wetland water supply channels will result in improvements in water quality in 31 miles of natural channel, 75 miles of wetland supply channels, and over 60,000 acres of wetlands. Establishing compliance with selenium objectives in Salt Slough and the wetland supply channels as the first priority protects the most sensitive use (waterfowl) and results in the greatest amount of environmental improvement as measured in total miles of improved water bodies when compared to the San Joaquin River and Mud Slough (north).

The next priority is compliance with selenium objectives in the San Joaquin River downstream of the Merced River. The selenium objective is based on protection of aquatic life [5 $\mu$g/L 4-day average (Consensus, 1995)]. Since water quality in the San Joaquin River downstream of the Merced River improves in response to load reductions, reductions in selenium load would be required throughout the period of non-compliance. These load reductions will continue until water quality objectives are met. Compliance with selenium objectives will result in improvements in water quality in 44 miles of natural channel. Establishing compliance with selenium objectives in the San Joaquin River downstream of the Merced River as the second priority results in a lesser extent of environmental improvement than described in the first priority.

The third priority is compliance with selenium objectives in Mud Slough (north) and the San Joaquin River between the mouth of Mud Slough (north) and the Merced River. The selenium objective is based on protection of aquatic life. Because there is little or no assimilative capacity in Mud Slough (north) and this segment of the San Joaquin River, load reductions, that are currently considered achievable will not improve water quality in these water bodies. There will be little or no improvement in water quality until subsurface drainage is removed from these water bodies. Once subsurface drainage is removed, water quality in 11 miles of natural channel will improve. Establishing compliance with selenium objectives in the San Joaquin River upstream of the Merced River and Mud Slough (north) as the third priority protects a use that is less sensitive than waterfowl and results in a lesser extent of environmental improvement than described in the first two priorities.

A summary of the five alternatives considered is presented in Table 4.

All five alternatives use the same approach, mechanism, and maximum compliance date for the wetland supply channels and Salt Slough - a prohibition will be used to cease discharge of agricultural subsurface drainage to these water bodies by October 1, 1996.

The five alternatives also use the same approach and mechanism for the San Joaquin River from Sack Dam to the Merced River and Mud Slough (north) - a prohibition will be used to cease discharge of agricultural subsurface drainage to these water bodies. The five alternatives differ significantly in the maximum compliance date; ranging from alternative one which would require compliance by October 1, 1996, to alternative two which would require compliance by October 1, 2020.

There are also significant differences between alternatives for the San Joaquin River downstream of the Merced River. The approach used in alternative one is to cease discharge of subsurface drainage, the approach used in alternatives 2-4 is to limit discharge of selenium through waste discharge requirements, and the approach used in alternative five is to limit the discharge of selenium by encouraging the adoption of best management practices (BMPs). Although alternatives 2-4 have common approaches and enforcement mechanisms, the maximum compliance dates differ significantly between alternatives. The maximum compliance date in alternative two is October 2010, for wet years and October 2020, for dry years. The maximum compliance date in alternative three is October 2005, for wet years and October 2010, for dry years. The maximum compliance date in alternative four is October 2000, for wet years and October, 2002 for dry years. The maximum compliance dates for alternatives three and five are the same, although the approaches differ.

Selection Criteria for Recommended Alternative

The selection of the recommended alternative is based on: 1) consistency with applicable state and Federal laws and policies; 2) the technical feasibility of meeting objectives in the time frame proposed; 3) the economic cost of meeting objectives in the time frame proposed; 4) the degree of beneficial use impairment that would occur during the period of non-compliance; and 5) the likelihood of successful compliance with the implementation program proposed.

Table 4. Summary of Approach, Mechanism, and Maximum Compliance Date for Alternatives 1-5.

| | Wetlands, Salt Slough | | | SJR Upstream of Merced; Mud Slough | | | SJR Downstream of Merced River | | |
|---|---|---|---|---|---|---|---|---|---|
| Alternative | Approach | Mechanism | Maximum Compliance Date | Approach | Mechanism | Maximum Compliance Date | Approach | Mechanism | Maximum Compliance Date |
| 1 | Cease Drainage | Prohibition | 10/1/1996 | Cease Drainage | Prohibition | 10/1/1996 | Cease Discharge | Prohibition | 10/1/1996 |
| 2 | Cease Drainage | Prohibition | 10/1/1996 | Cease Drainage | Prohibition | 10/1/2020 | Effluent Limits | WDRs | 10/2010;Wet 10/2020;Dry |
| 3 | Cease Drainage | Prohibition | 10/1/1996 | Cease Drainage | Prohibition | 10/1/2010 | Effluent Limits | WDRs | 10/2005;Wet 10/2010;Dry |
| 4 | Cease Drainage | Prohibition | 10/1/1996 | Cease Drainage | Prohibition | 10/1/2002 | Effluent Limits | WDRs | 10/2000;Wet 10/2002;Dry |
| 5 | Cease Drainage | Prohibition | 10/1/1996 | Cease Drainage | Prohibition | 10/1/2010 | Encourage BMPs | None | 10/2005;Wet 10/2010;Dry |

**Approach** - the strategy used for accomplishing water quality objectives in a class of water bodies.

**Cease Drainage** - agricultural subsurface drainage must be removed from that class of water body or treated to meet water quality objectives.

**Effluent Limits** - load limits would by set on the discharge of selenium from agricultural subsurface drainage.

**Encourage BMPs** - the Regional Board would encourage the adoption of Best Management Practices that it felt would lead to compliance with water quality objectives.

**Mechanism** - the regulatory mechanism employed to implement the approach.

**Prohibition** - a prohibition of discharge of agricultural subsurface drainage would be imposed for the water bodies, if water quality objectives were not met.

**WDRs** - waste discharge requirements would be used to establish effluent limits.

**Maximum Compliance Date** - Compliance must be achieved no later than the date specified.

**Wet/Dry** - wet years are defined as above normal and wet water years per the San Joaquin River Index. Dry years are defined as critically dry, dry, and below normal per the San Joaquin River Index.

Consistency with Applicable state and Federal laws and policies

Development of an implementation program for non-point sources of pollution must be consistent with state and Federal laws and policies. Those laws and policies evaluated below represent areas in which the five alternatives differ. The laws and policies evaluated are the State Water Board's Nonpoint Source (NPS) Management Plan (Resolution No. 88-123), the State Water Board's Pollution Policy Document (Resolution No. 90-67), the San Joaquin Valley Drainage Program (Final Report; SJVDP, 1990a), and state and Federal anti-degradation policies.

*Nonpoint Source Management Plan*

In 1988, the State Water Board adopted a Nonpoint Source Management Plan (Resolution No. 88-123). The plan described three tiers for addressing nonpoint source pollution problems: 1) a voluntary approach; 2) the regulatory encouragement of BMP implementation; and 3) the adoption of effluent limits. The least stringent option which results in successful compliance with water quality objectives is to be chosen. Although not explicitly considered in the NPS Management Plan, the Regional Board has the authority to adopt a prohibition of discharge as a means to achieve compliance with water quality objectives. The current implementation program uses a Tier 2 approach - the regulatory encouragement of BMP implementation.

All five alternatives use a prohibition of discharge to meet water quality objectives in the wetland supply channels, Mud Slough (north), Salt Slough, and the San Joaquin River upstream of the Merced River. Alternative 1 also uses a prohibition of discharge to meet water quality objectives in the San Joaquin River downstream of the Merced River. Alternative 1 does not use the least stringent regulatory option, since reducing selenium loads by establishing effluent limits may result in compliance with water quality objectives in the San Joaquin River downstream of the Merced River confluence. Alternative 5 uses regulatory encouragement of BMP adoption to meet water quality objectives. Since this approach was previously used and did not result in compliance, it is unlikely that a similar regulatory approach would work for more stringent objectives. Alternatives 2-4 propose the use of effluent limits to meet water quality objectives in the San Joaquin River downstream of the Merced River confluence. The NPS Management Plan suggests the use of effluent limits, if the regulatory encouragement of BMP adoption does not result in compliance.

In summary, alternatives 1 and 5 are not consistent with the State Water Board's Nonpoint Source Management Plan. Alternative 1 proposes an approach that is not the least stringent option that is likely to result in compliance and alternative 5 proposes an approach that is not stringent enough based on past performance. Alternatives 2-4 are the most consistent with the State Water Board's Nonpoint Source Management Plan, since a more stringent regulatory program is proposed than previously used.

*Pollutant Policy Document*

The State Water Board Pollution Policy Document (Resolution No. 90-67) requires the Central Valley Regional Board to develop a strategy for reducing selenium loading to the Delta. This strategy must be reflected in updates to the Basin Plan. Alternative 1 would remove all major sources of selenium load to the San Joaquin River; while limits on selenium load would be imposed under alternatives 2-4. No limits on selenium load would be imposed under alternative 5. The degree of load reduction under alternative 5 would depend on the success of BMP implementation. Alternative 5 is the only alternative that is not consistent with the State Water Board's Pollution Policy Document.

*San Joaquin Valley Drainage Program*

In January 1992, the State Water Board chairman signed a Memorandum of Understanding (MOU) with various state and federal agencies. The MOU is an agreement by the agencies to use the management plan described in the September 1990 final report of the San Joaquin Valley Drainage Program Final Report (SJVDP, 1990a) as a guide for remedying subsurface drainage and related problems. For the Grassland watershed, the Final Report recommends: 1) drainage discharge to the San Joaquin River in a conveyance channel which isolates the drainage from the wetland channels, Salt Slough, Mud Slough (north), and the San Joaquin River upstream of the Merced River; and 2) the implementation of alternatives which would lead to reduction in selenium loading to the San Joaquin River downstream of the Merced River. The recommended alternatives include improvements in irrigation practices, land retirement, ground water management, and drainage reuse (which includes agroforestry plots). Alternative one is not consistent with the recommendations in the Final Report, since no discharge to the San Joaquin River is allowed. Alternatives 2-5 allow continued discharge to the San Joaquin River, but would require the construction of a separate conveyance facility for subsurface drainage discharges. Alternatives 2-4 are consistent with many of the recommendations of the Final Report since strict effluent limits will be imposed. Adoption of the recommendations of the Final Report is less likely under alternative 5, since there is not a strong regulatory incentive to meet water quality objectives.

*Antidegradation*

The Regional Board must also assure that its actions do not violate the state and federal antidegradation policies. Where applicable, these policies generally prohibit the degradation of water quality except under specified circumstances. As explained below, the Regional Board has determined that neither the state nor the federal antidegradation policies apply to the Basin Plan amendment.

The state antidegradation policy (State Water Resources Control Board Resolution 68-16) generally prohibits degradation of water whose quality is better than the quality established in policies as of the date on which such policies become effective. The water quality of the waters subject to this amendment has not been better than the water quality objectives that have been in existence, and the existing water quality is not better than the water quality objectives that are included in this amendment. Resolution 68-16 does not apply.

The federal antidegradation policy (40 CFR Section 131.12) includes a three-part test to protect existing water quality. The policy generally requires protection of the level of water quality that has existed since adoption of the policy, on November 28, 1975. The policy requires (1) Existing uses and water quality necessary to protect those uses be maintained and protected; (2) Where water quality exceeds the levels necessary to protect fish, wildlife and recreation, that quality be maintained and protected unless degradation is necessary to accommodate important economic or social development; and (3) The quality of high quality waters constituting an outstanding National resource be maintained and protected. The water quality of the waters subject to this amendment have not been able to protect beneficial uses since November 28, 1975. In addition, there will be no increase in mass emissions of selenium under any of the implementation alternatives reviewed for the proposed Basin Plan amendment. Therefore, the federal antidegradation policy does not apply.

A review of water quality since November 28, 1975 indicates there will be no increase in mass emissions of selenium. All the implementation alternatives reviewed will achieve successive improvements in water quality until compliance with water quality objectives is achieved. An immediate improvement in water quality in a large number of the wetland water supply channels is also expected. Common to all of the alternatives that will result in the above water quality improvements are the following:

- no new discharges are proposed;
- no new increase in mass emissions of selenium from the Grassland watershed;
- implementation of progressively lower water quality goals aimed at long-term compliance with water quality objectives;
- prohibition of agricultural subsurface drainage discharges to wetland water supply channels and Salt Slough.

As noted in Part III of this report, the hydrology of the Grassland watershed is managed. Under the alternatives considered, there are no new discharges being proposed. Compliance with the proposed discharge prohibitions, would likely cause a reconfiguration of the managed hydrology but will not result in additional selenium discharged from the Grassland watershed.

All of the alternatives provide for prohibition of discharge of selenium from the Grassland watershed in excess of 8,000 pounds per year. This value is based on historical average maximum amount of selenium discharged. This provision insures that there will be no increase in mass emissions from the watershed.

All of the alternatives provide for meeting successively more stringent water quality goals that are aimed at meeting water quality objectives by the compliance date. This provision will result in eventual compliance with water quality objectives. Since the proposed water quality objectives are not currently being met, the various alternatives will result in improvement in water quality over the present condition.

Common to the various alternatives is the prohibition of agricultural subsurface drainage discharges to the wetland supply channels and Salt Slough as of October 1, 1996. Implementation of this provision will result in removal of poor quality agricultural subsurface drainage from 31 miles of natural channels and 93 miles of wetland supply channels. The removal of drainage insures that beneficial uses of these water bodies are protected.

In conclusion, because no additional selenium discharges will occur as a result of any of the alternatives and because water quality improvements will progressively occur until water quality objectives are achieved, all alternatives would result in improvement in water quality over the present condition.

Technical Feasibility

The potential technical solutions to complying with the various alternatives are evaluated below.

*Plugging Drains*

Implementation of alternative one would require the plugging of tile drains. Plugging drains does not require the development of new technology, so it is technically feasible.

*Drainage Conveyance Facility*

Alternatives 2-5 assume the construction of a separate drainage conveyance facility to the San Joaquin River below the Merced River in order to meet the objectives in Mud Slough, Salt Slough and the wetland channels due to their limited assimilative capacities. The Grassland Bypass (USBR, 1995a) that is currently being implemented by the San Luis & Delta-Mendota Water Authority will remove drainage from Salt Slough and the wetland supply channels and convey it to Mud Slough (north). The Grassland Bypass uses a portion of the San Luis Drain and includes a new channel to convey the drainage to the San Luis Drain. An extension of the Grassland Bypass to the San Joaquin River will require the construction of an additional eight miles of channel, as outlined in the San Joaquin Valley Drainage Program Final Report (SJVDP, 1990a). The estimated cost of this channel is between $16-$28 million and would go through both Federal and state wildlife refuges. Alternative two allows the greatest amount of time to complete the extension (maximum compliance date October 1, 2020), alternatives three and five allow less time (maximum compliance date October 1, 2010), and alternative four allows the least amount of time to complete the extension (maximum compliance date October 1, 2002).

*Status of Selenium Load Reduction Options*

Successful implementation of alternatives 2-5 relies on the development of selenium load reduction options. Selenium load reduction is required to meet the water quality objective in the San Joaquin River below the Merced River.

Staff has estimated the effectiveness of four selenium load reduction options: 1) improved irrigation practices; 2) land retirement; 3) agroforestry; and 4) treatment (see Appendix 3). Implementation of improved irrigation practices and land retirement are not constrained by research and development needs. Both agroforestry and treatment require additional time for development prior to implementation. Currently, there are few agroforestry demonstration plots in the Grassland watershed. Demonstration of the effectiveness of agroforestry in the Grassland watershed will take a minimum of 3-5 years (allowing time for the trees to mature). There are several drainage water treatment processes which are being evaluated at the pilot scale and it will likely take several years before the optimum process is selected and ready for implementation at the plant scale.

The compliance time schedules developed for alternatives 2-5 were assessed based on the time required to develop and implement the agroforestry and treatment options and the cost of implementing those options. Load reductions necessary to meet proposed water quality objectives represent a 47% reduction in load in wet years and a 80% reduction in dry years from the historical average. The evaluation of each alternative assumed that implementation of improved irrigation practices and the agroforestry option would result in compliance with the selenium water quality objective in wet years, but treatment would be required to meet the objective in dry years.

Alternative 2 allows for a long period of development and implementation of new technologies. The maximum compliance date for meeting water quality objectives in wet years is October 1, 2010 and the maximum compliance date for meeting water quality objectives in dry years is October 1, 2020. These extended compliance dates allow for setbacks in development and would minimize the economic impact of meeting selenium objectives. Alternative 3 would require aggressive development and implementation of new technologies. The maximum compliance date for meeting water quality objectives in wet years is October 1, 2005 and the maximum compliance date for meeting water quality objectives in dry years is October 1, 2010. If no major setbacks occur in development or implementation, adequate time is available to implement new technologies. The economic impact would be greater than alternative 2, since the compliance time period is shortened by 5-10 years. Alternative 4 would require almost immediate implementation of technologies that have not yet completed the development stage. The maximum compliance date for meeting water quality objectives in wet years is October 1, 2000 and the maximum compliance date for meeting water quality objectives in dry years is October 1, 2002. This alternative has the least likelihood of success, since the new technologies will not be optimized prior to implementation. The short compliance time period would also have the greatest economic impact. Alternative 5 is equivalent to alternative 3 in terms of maximum compliance, but there is no regulatory mechanism in place if compliance does not occur.

<u>Screening of Alternatives</u>

Each of the alternatives was evaluated relative to the criteria described above (Table 5). An extensive discussion of each alternative is included in Appendix 2 and provides the rational for the scoring of each alternative for the given criteria.

Under the category of consistency with State and Federal laws and policies, each of policies evaluated was assessed as to whether it was or was not consistent, while under the category of technical feasibility, each alternative was ranked relative to the availability of technology to accomplish the goals in the time frame proposed with the mechanism proposed (Table 5). Scores between 0 and 5 were given. A score of zero would indicate that the alternative was not technically feasible (the technology would not be available in the time frame proposed) and a score of 5 would indicate that the technology was currently available. Intermediate scores indicate the likelihood of the availability of technology in the time frame proposed.

The economic cost criteria provides a relative score on the economic impact of meeting water quality objectives using the approach and time frame proposed by a given alternative. A score of zero indicates the greatest relative economic cost and a score of five represents the lowest relative economic cost.

Table 5. Comparison of Alternatives Relative to State and Federal laws and Policies and Scoring of Alternative Relative to Feasibility, Cost, Degree of Impairment, and Likelihood of Success.

| Consistency with State and Federal laws and policies | Alternative 1 Immediate Prohibition of Discharge | Alternative 2 Effluent Limits -Max. 25 yrs. for Compliance | Alternative 3 Effluent Limits -Max. 15 yrs. for Compliance | Alternative 4 Effluent Limits -Max. 7 yrs. for Compliance | Alternative 5 Encouragement of BMP Implementation - 15 yrs. for compliance |
|---|---|---|---|---|---|
| - State Bd. Non-point Source Management Policy | NOT Consistent | Consistent | Consistent | Consistent | NOT Consistent |
| - State Bd. Pollution Policy Document | Consistent | Consistent | Consistent | Consistent | NOT Consistent |
| - San Joaquin Valley Drainage Program Final Report | NOT Consistent | Consistent | Consistent | Consistent | Consistent |
| - Anti-degradation policy | Consistent | Consistent | Consistent | Consistent | Consistent |
| | | | | | |
| Criteria Evaluated | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
| a) Technical feasibility of meeting objectives in the time frame proposed | 3 | 5 | 4 | 1 | 4 |
| b) Economic cost of meeting objectives in time frame proposed | 1 | 5 | 3 | 0 | 3 |
| c) Degree of impairment that would occur during period of non-compliance | 5 | 0 | 3 | 4 | 3 |
| d) Likelihood of successful compliance with the implementation program proposed. | 5 | 4 | 3 | 1 | 1 |
| Total | 14 | 14 | 13 | 6 | 11 |

A score of 0-5 is given to each criteria. The method used to score each alternative for a given criteria is discussed in the text under "Screening of Alternatives".

| | | |
|---|---|---|
| a) | not feasible in time frame proposed (0) | currently available (5) |
| b) | high cost (0) | low cost (5) |
| c) | high impairment (0) | low impairment (5) |
| d) | low compliance potential (0) | high compliance potential (5) |

The degree of impairment criteria provides a relative score on the amount of impairment that would occur during the period of non-compliance. A score of zero indicates a high degree of relative impairment (compared to the other alternatives) and a score of five indicates a low degree of relative impairment.

The criteria on the likelihood of successful implementation scores each alternative with respect to its potential to achieve selenium water quality objectives with the mechanism proposed and in the time frame proposed. A score of zero represents a low probability of successful implementation and a score of five represents a high probability of successful implementation.

<u>Recommended Alternative</u>

Alternative 1 is inconsistent with both the State Board's NPS Management Policy and the recommendations of the San Joaquin Valley Drainage Program Final Report. Alternative 5 is inconsistent with both the State Board's NPS Management Policy and the State Board's Pollution Policy Document. Due to the inconsistencies with State policy and memorandum of understanding, these alternatives were not considered viable at this time. Alternatives 2-4 are consistent with State and Federal laws and policies and were evaluated relative to the other four criteria considered. Based on the weight given to each criteria, alternative 2 is scored slightly higher than alternative 3. The extended compliance schedule proposed under alternative 2 increases the likelihood of success, the technical feasibility, and minimizes the economic cost. These benefits are contrasted with the environmental costs of an extended period of non-compliance and degradation of water quality in Mud Slough (north). These costs make alternative 2 unacceptable, and, therefore, it is not recommended.

**Alternative 3 is recommended since it provides a balance between the economic cost, likelihood of success, and period of non-compliance.**

## POLICIES

A policy that is adopted into the Water Quality Control Plan for the San Joaquin River (Basin Plan) becomes official guidance of the Regional Board for its programs. In addition, other agencies will be expected to implement these policies in their programs. The policies reviewed below are intended to be part of the institutional basis for control of agricultural subsurface drainage discharges and to provide direction to staff and other agencies. Local agencies, especially water purveyors are likely to play a major role in implementing these policies.

There are six existing policies regarding the control of agricultural subsurface drainage discharges. Modifications and clarifications have been made to four of these existing policies. Two additional policies are proposed which focus actions on optimizing beneficial use attainment and regulating selenium discharges through load reductions. The policy language which would be included in the Basin Plan is presented below with the rationale for each of the policies, whether existing or revised, as well as consistency with the revised approach proposed for the regulation of subsurface agricultural discharges.

### Staff Analysis of Policy Needs

The existing Basin Plan policies were evaluated as to whether they remain consistent with the present needs to regulate agricultural subsurface drainage. Four of the existing policies are proposed for revision and two new policies are proposed. The rationale for the revisions and the two new policies are discussed here.

a. **The control of toxic trace elements in agricultural subsurface drainage, especially selenium, is the first priority. (Existing - unchanged)**

This existing policy in the Basin Plan establishes that priority is given to the control of selenium. Specifically, the policy indicates that efforts to control selenium should be given first priority in the allocation of resources. The basis for the policy was that the Regional Board felt that efforts to control selenium should be more intensive and that the dischargers should be prepared to accept greater burdens to improve water quality due to known impacts to beneficial uses. Emphasis for selenium control was to be directed at discharges entering the San Joaquin River from the west side, upstream of the Merced River, the major source of selenium loading.

Data collected since the policy was adopted as part of the Basin Plan in 1988, continues to point to the importance of selenium in agricultural subsurface drainage as a significant threat to wildlife and aquatic life resources. Research since 1988, points to the greatest immediate threat being to wildlife, especially aquatic birds. This focus is not to downplay the threat to aquatic life, only to point out its significance when associated with documented wildlife impacts.

Previously it was thought that various toxic trace elements may also represent a threat to public health. At present this threat appears to only be associated with impacts occurring with subsistence consumption of wildlife and aquatic life that have been exposed to elevated concentrations of selenium.

Thus, while the control of all constituents for which there are water quality objectives is important, selenium continues to present an immediate threat to wildlife and aquatic life resources and deserves of the highest priority in the allocation of resources.

**b. Activities that increase the discharge of poor quality agricultural subsurface drainage ~~are prohibited~~ will be discouraged through the adoption of prohibitions of discharge and other control measures. (Existing - Revised)**

The wording of the policy language has been changed to clarify the intent of the original policy. In the Basin Plan, policies and prohibitions come under different headings. Several prohibitions are proposed in a later section as the method to implement this policy which "discourages" the increase in agricultural subsurface drainage discharges. This revision allows the Regional Board the latitude to use not only targeted prohibitions of discharge but other measures to control subsurface drainage.

The original policy was adopted in 1988 based on potential impacts from the installation of new subsurface drainage systems. In adopting the 1988 policy, the Regional Board recognized that the installation of new subsurface drainage facilities or the expansion of existing facilities could exacerbate the water quality problems due to discharges of agricultural subsurface drainage. The staff report described the boundaries of this policy as:

*"The installation of new subsurface drainage facilities* or the expansion of existing facilities* in areas where the drainage produced has an average selenium concentration greater then 20 ug/L is prohibited. The installation of new subsurface drainage facilities or expansion of existing facilities in areas where the drainage produced has an average selenium concentration greater than 5 ug/L and less than or equal to 20 ug/L is prohibited unless the grower and landowner have a water conservation and management plan approved by both the local drainage or irrigation district and Regional Board Executive Officer for the area to be served by the drainage facilities.*

* *For the purposes of the implementation program, subsurface drainage facilities includes tile drainage systems, drainage wells, and any deep open drains that intercept ground water."*

The 1988 staff report, in describing the implementation of this policy, stated that the Regional Board would consider granting a variance to the installation prohibition in areas where drainage selenium concentrations are greater than 20 ug/L provided that:

*1) the grower and landowner have a water conservation and management plan approved by both the local drainage or irrigation district and the Regional Board Executive Officer; and*

*2) they can demonstrate that other drainage reduction actions will be taken by the owner or grower concurrently with the installation of new drainage facilities such that there is a net decrease in the selenium mass load discharged in the agricultural subsurface drainage.*

The 1988 staff report also indicated that "*the Regional Board will consider rescinding the prohibition when selenium water quality objectives are met.*" To date however, the water quality objectives have not been met in either the Grassland sloughs or in the San Joaquin River therefore a policy which discourages any increase is still valid.

c. **The control of agricultural subsurface drainage will be pursued on a regional basis. (Existing - unchanged)**

The responsibility for subsurface drainage discharges lies with all those generating the drainage water. Those generating the drainage, however, may not be the same as those discharging or managing the discharge flows downstream. Because of the differing levels of responsibility, the Board, in adopting this policy in 1988, recognized that the control of agricultural subsurface drainage would only be accomplished through a mixture of water management practices at the farm level and drain flow management on the watershed level. This combined management program would best be implemented on a regional basis.

In many cases, subsurface drainage facilities are collecting and discharging drainage water in excess of that generated by the land being irrigated immediately overlying the subsurface drains. Land under irrigation or water supply facilities upslope of the subsurface drainage facilities most likely contribute to the volume and pollutant load discharged by downgradient facilities. Source controls, such as improved water distribution and water use practices, are the most effective means to reduce these flows and are best implemented over a large area that may involve several entities.

Conveyance and management of the drainage water discharged in the Grassland watershed is done through an extensive network of canals and drains. Because the entire Grassland watershed is a series of effluent dominated channels, improved management of these flows is the key to water quality improvements. Management is most effectively done on a regional basis because no one entity controls the interconnected network of canals and drains that serve the Grassland watershed.

The drainage that leaves the Grassland watershed is dependent upon the management actions taken at both the field and watershed levels. This discharge is managed most effectively through regional efforts of source control and drainage water management. The Regional Board still considers agricultural subsurface drainage discharges a regional problem and a regional approach will most efficiently and fairly provide a solution. The regional approach should be pursued by all agencies.

d. **The reuse of agricultural subsurface drainage will be encouraged and actions that would limit or prohibit ~~it~~ reuse discouraged. (Existing - Revised)**

The revision to this policy was strictly editorial to provide clarity. In adopting this policy in 1988, the Regional Board recognized that the optimal use of available water supplies in the San Joaquin River Basin should be the goal of all public and private interests in the basin. Higher salinity drainage water can be used for intermittent periods for various beneficial uses including agricultural irrigation.

Reuse can be an integral component of a program to reduce the volume of drainage water but the reuse must be done in a manner that does not aggravate an existing toxic trace element problem or create a long-term salinity problem. The need to control salt buildup may require periodic reclamation. The practice of reclamation may result in large pulses of poor quality water even greater than currently observed. For example, reuse by blending currently takes place in much of the agricultural subsurface Drainage Problem Area. This blending however may raise the salinity of the supply water to all farms and may increase the need for leaching salts from the soil. This leaching to groundwater thus increases the amount of drainage water that must be discharged.

The Regional Board should continue with their policy; however, an evaluation needs to be conducted on the appropriate level of reuse and blending that is compatible with needs for controlling toxic trace element sources in the basin.

e. **~~Of the two major options for disposal of salts produced by agricultural irrigation;~~ ~~e~~Export out of the basin of accumulated salts due to agricultural irrigation and wetlands management ~~has less potential for environmental impacts and, therefore,~~ is the favored disposal option. The San Joaquin River may continue to be used to remove these salts from the basin so long as water quality objectives are met. (Existing - Revised)**

The Regional Board in adopting this policy in 1988 recognized that to maintain economic viability in the San Joaquin River Basin, irrigated agriculture, wetlands and other land uses must have a means of disposing of salts. The feasible near-term alternatives for the subsurface drainage water were to isolate salts in the basin using evaporation basins or to continue to export salt out of the basin. Studies since 1988 have indicated the potential for environmental impacts from the accumulation of selenium in evaporation basins. Since agricultural subsurface drainage in this portion of the San Joaquin Valley contains selenium and, the San Joaquin River is the only basin outlet, using the river to remove salts is the logical disposal option. The water quality of the River is important and the policy stresses that water quality objectives must be met in order for the River to be utilized in this manner. This policy statement is still valid but long-term selenium accumulation in the aquatic environment is a very important issue, therefore, all efforts should be made to minimize the total load of selenium that is discharged into the River and insure that water quality objectives within the river are met.

f. **~~The~~ A valley-wide drain to carry ~~the~~ salts ~~generated by agricultural irrigation~~ out of the valley remains the best technical solution to the water quality problems of the San Joaquin River and Tulare Lake Basins. The drain would carry wastewater high in salt and unfit for reuse that is generated by municipal, industrial, agricultural and wetland management activities.**

**The Regional Board, at this time, feels that a valley-wide drain will be the only feasible, long-range solution for achieving a salt balance in the Central Valley. The Regional Board favors the construction of a valley-wide drain under the following conditions:**

**All toxicants would be reduced to a level which would not harm beneficial uses of receiving waters;**

**The discharge would be governed by specific discharge and receiving water limits in an NPDES permit; and**

**Long-term, continuous biological monitoring would be required. (Existing - Revised)**

The proposed addition of language regarding "wastewater high in salt and unfit for reuse" makes this policy consistent with language adopted into the Tulare Lake Basin Plan (1995) (CVRWQCB, 1995b).

As stated above (Policy "e"), the Regional Board recognizes that to maintain economic viability in the San Joaquin River Basin, irrigated agriculture, wetlands and other land uses must have a means of disposing of salts. The Regional Board has recognized this problem and has, since 1975, continuously supported the construction of a valley-wide drain as the means to solve this problem. The Basin Plan also provides that water quality objectives and an NPDES permit would be adopted for the discharge from the valley-wide drain.

This policy reaffirmed the Regional Board position that a valley-wide drain is needed and is the best technical solution to the water quality problems being caused by the generation of these salts and present disposal practices. This policy remains valid today and the drain completion should be pursued by the U.S. Bureau of Reclamation (USBR) and California Department of Water Resources (DWR).

g. **Optimizing protection of beneficial uses on a watershed basis will guide the development of actions to regulate agricultural subsurface drainage discharges. (New)**

In the Grassland watershed where hydrologic manipulations and land uses have resulted in an effluent dominated hydrologic system, management steps need to be taken that optimize beneficial uses. Rather than focus efforts on individual water bodies, those actions which lead to the greatest improvement in the watershed as a whole should be given priority. This would be consistent with the present Regional Board policy emphasizing a watershed approach to water quality improvement.

Actions needed for implementation should be prioritized based on the sensitivity of the use to be protected and the extent of improvement expected in the watershed as a whole. The focus of this effort should be to ensure that all beneficial uses are maintained in the watershed and enhanced where appropriate. This policy allows for short-term degradation of individual water bodies, if the overall watershed is enhanced. Long-term protection of individual water bodies is still required under this policy.

Flow and water quality in the Grassland watershed channels is controlled and dominated by land use practices within the watershed, principally agricultural and wetlands land uses.

Recent monitoring data shows that when agricultural subsurface drainage is present, its quality dominates the water body. Because of the strong dominance, beneficial use is not likely to improve until there is no agricultural subsurface drainage water present in the channel.

Restricting drainage water to the least number of water bodies as possible would assist in obtaining a higher level of beneficial use in the remaining channels. While the channels that are free of selenium-laden agricultural subsurface drainage will attain their full potential for beneficial uses, others will be strongly dominated by such flows. In the channels with drainage water, full attainment of beneficial use may be difficult or impossible to attain until the drainage water is removed from the channel. The net result of such an effort would be a higher level of beneficial use attainment in most Grassland channels than would otherwise be possible; thereby maximizing beneficial uses in the watershed and focusing the resolution of beneficial use attainment to a few channels.

**h. For regulation of selenium discharges, actions need to be focused on selenium load reductions. (New)**

Section 303(d) of the Federal Clean Water Act requires the development of a Total Maximum Daily Load (TMDL) for water quality impaired streams (water quality limited segment). The lower San Joaquin River is designated as a water quality limited segment. The TMDL sets the maximum pollutant load that can be discharged without violating water quality objectives. Staff developed a method to assess the maximum allowable discharge of selenium to the San Joaquin River (Karkoski, et al, 1993; Karkoski, 1994). This analysis indicates that significant load reductions will be required to meet selenium water quality objectives.

This assessment is consistent with selenium data collected in the San Joaquin River which indicates that water quality improves in response to load reductions. This data leads the Regional Board to conclude that load reductions are an effective means of meeting long-term beneficial use protection in the San Joaquin River. In addition, load reductions should benefit the Sacramento-San Joaquin Delta. Bioaccumulation is of concern in estuaries such as the Delta even if the selenium concentration is low, since the organisms are exposed to selenium, for longer periods of time than in river systems. Recent data from the San Francisco Bay and the Sacramento-San Joaquin Estuary shows that selenium bioconcentration can be significant even at selenium concentrations below the existing Federal water quality criteria.

## POTENTIAL CONTROL ACTIONS

This section describes the nature of the actions that may be used to control agricultural subsurface drainage discharges within the Grassland watershed and those that enter the San Joaquin River. These control actions are directed at selenium. Control actions that are focused on salinity and boron will be considered at a later time as part of a full basinwide plan for control of these elements. Some control actions described below require implementation by agencies or institutional bodies other than the Regional Board.

There is an existing implementation strategy in the Basin Plan. Modifications, clarifications and additions to the strategy are suggested here with Table 6 outlining the proposed changes to the existing strategy. The control actions focus on the watershed as a single management unit and a stronger use of regulatory actions, including the use of waste discharge requirements, while maintaining flexibility to allow for adjustments as experience is gained. The proposed Basin Plan language is consistent with the management strategy described below and includes Prohibitions; Actions Recommended for Implementation by Other Agencies; and Actions and Schedule to Achieve Water Quality Objectives. The rationale behind the proposed changes to the Basin Plan implementation strategy is discussed below.

### Protection of Beneficial Uses

#### Watershed Approach

The San Joaquin Valley Drainage Program Final Implementation Plan (SJVDP, 1990a) described the Grassland watershed as a separate subarea with regard to controlling agricultural subsurface drainage. The actions described in SJVDP (1990a) were specific to the Grassland watershed. Those actions included source control, drainage water reuse, evaporation systems, land retirement, groundwater management, discharge to the San Joaquin River, protection and restoration of fish and wildlife habitat including provision of substitute water supplies and institutional changes. Development of a watershed approach to developing control actions is consistent with the Regional Board policy of considering water quality improvements on a watershed basis.

As discussed in the beneficial use description, many of the Grassland watershed channels are either constructed for a particular use or are reconstructed natural channels that are effluent dominated. The level of beneficial use that can be attained in these water bodies is heavily dependent upon the water management associated with the land uses within the watershed. Improvement in beneficial use attainment will, therefore, be associated not only with pollutant reduction but with changes in water management. Consistent with Regional Board policy, the pollutant of greatest importance is selenium and all actions for the current implementation program will be based on a watershed approach to meeting selenium objectives in the San Joaquin River and Grassland channels. Rather than considering actions using a water body by water body approach, the net improvement to water quality in the watershed as a whole is considered.

Table 6. Proposed Changes to the Control Actions Governing the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin Valley

## Prohibitions

~~Activities that increase the discharge of poor quality agricultural subsurface drainage are prohibited. (This is part of the San Joaquin River Agricultural Subsurface Drainage Policy discussed on page IV-17.)~~

a. The discharge of agricultural subsurface drainage from the Grassland watershed to the San Joaquin River or its tributaries from any on-farm subsurface drain, open drain, or similar drain system is prohibited, unless such discharge began prior to (the effective date of this amendment) or unless such discharge is governed by waste discharge requirements.

b. The discharge of agricultural subsurface drainage water to Salt Slough and wetland water supply channels identified in Appendix 40 is prohibited after 1 October 1996, unless water quality objectives are being met. This prohibition may be reconsidered if public or private interests prevent the implementation of a separate conveyance facility for agricultural subsurface drainage.

c. The discharge of agricultural subsurface drainage water to Mud Slough (north) and the San Joaquin River from Sack Dam to the mouth of the Merced River is prohibited after 1 October 2010, unless water quality objectives are being met. This prohibition may be reconsidered if public or private interests prevent the implementation of a separate conveyance facility for agricultural subsurface drainage to the San Joaquin River.

d. The discharge of selenium from agricultural subsurface drainage systems in the Grassland watershed is prohibited in amounts exceeding 8,000 lbs/year for all water year types beginning 1 October 1996.

## Actions Recommended for Implementation by Other Agencies

State Water Board

1. ~~As a last resort and where the withholding of irrigation water is the only means of achieving significant improvements in water quality, t~~The Regional Board will ~~consider~~ request~~ing~~ that the State Water Board use its water rights authority to preclude the supplying of water to specific lands, if water quality objectives are not met by the specified compliance dates and Regional Board administrative remedies fail to achieve compliance.

~~2. The State Water Board should require all water agencies in the San Joaquin Basin, regardless of size, to submit an "informational" report on water conservation.~~

2~~3.~~ The State Water Board should work jointly with the Regional Board in securing compliance with the 2 $\mu g/l$ selenium objective for managed-wetlands in the Grassland area.

~~4. The State Water Board give first priority to the use of the Water Conservation and Water Quality Bond Law of 1986 funds for subsurface drainage pollutant control projects in the San Joaquin Basin, especially in those areas that contribute selenium to the San Joaquin River.~~

3 ~~5.~~ The State Water Board should also consider ~~utilizing State Assistance Program g~~Grant funds to implement a cost share program to install a number of flow monitoring stations within the Grassland area to assist in better defining the movement of pollutants through the area.

## Table 6. Proposed Changes to the Control Actions Governing the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin Valley (Continued)

State Water Board (continued)

4 ~~6.~~ The State Water Board should continue to consider the Drainage Problem Area in the San Joaquin Basin and the upper Panoche watershed (in the Tulare Basin) as priority nonpoint source problems in order to make USEPA nonpoint source control funding available to the area.

5. The State Water Board should seek funding for research and demonstration of advanced technology that will be needed to achieve final selenium loads necessary to meet selenium water quality objectives.

Other Entities

1. The entire drainage issue is being handled as a watershed management issue. The entities in the Drainage Problem Area and entities within the remainder of the Grassland watershed need to establish a regional entity with authority and responsibility for drain water management.

2 The regional drainage entity and agricultural water districts should consider adopting economic incentive programs as a component of their plans to reduce pollutant loads. Economic incentives can be an effective institutional means of promoting on-farm changes in drainage and water management.

3 ~~1.~~ If fragmentation of the parties that generate, handle and discharge agricultural subsurface drainage jeopardizes the achievement of water quality objectives, the Regional Board will consider petitioning the Legislature for the formation of a regional drainage district.

4 ~~2.~~ The Legislature should consider putting additional bond issues before the voters to provide low interest loans for agricultural water conservation and water quality projects and incorporating provisions that would allow recipients to be private landowners, and that would allow irrigation efficiency improvement projects that reduce drainage discharges to be eligible for both water conservation funds and water quality facilities funds.

5 ~~3.~~ The San Joaquin Valley Drainage Implementation Program should continue to investigate the alternative of a ~~local~~ San Joaquin River Basin drain to move the existing discharge point for poor quality agricultural subsurface drainage to a location where its impact on water quality is less. ~~The San Joaquin Valley Drainage Program should also investigate the plan to use the San Luis Drain (the Zahm-Sansoni Plan) as the first phase of this alternative.~~

~~4. The US Bureau of Reclamation should give the districts and growers subject to this program first priority in their water conservation loan program.~~

6. The selenium water quality objective for the wetland channels can not be achieved without removal of drainage water from these channels. The present use of the Grassland channels has developed over a 30-year period through agreements between the dischargers, water and irrigation districts, the U.S. Bureau of Reclamation, the California Department of Water Resources, the U.S. Fish and Wildlife Service, the California Department of Fish and Game, the Grassland Water District and the Grassland Resource Conservation District. Because each entity shared in the development of the present drainage routing system, each shares the responsibility for implementation of a wetlands bypass.

Table 6. Proposed Changes to the Control Actions Governing the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin Valley (Continued)

## Actions and Schedule to Achieve Water Quality Objectives

1. In developing control actions for selenium, the Regional Board will utilize a priority system which focuses on a combination of sensitivity of the beneficial use to selenium and the environmental benefit expected from the action.

2. Control actions which result in selenium load reduction are most effective in meeting water quality objectives.

3. With the uncertainty in the effectiveness of each control action, the regulatory program will be conducted as a series of short-term actions that are designed to meet long-term water quality objectives.

~~4. Best management practices, principally water conservation measures, are applicable to the control of agricultural subsurface drainage.~~

4. Performance goals will be used to measure progress toward achievement of water quality objectives for selenium. Prohibitions of discharge and waste discharge requirements will be used to control agricultural subsurface drainage discharges containing selenium. Compliance with performance goals and water quality objectives for nonpoint sources will occur no later than the dates specified in Table IV-4.

**Table IV-4 SUMMARY OF SELENIUM WATER QUALITY OBJECTIVES AND COMPLIANCE TIME SCHEDULE**

**Selenium Water Quality Objectives (in bold) and Performance Goals (in italics)**

| Water Body/Water Year Type [1] | 1 October 1996 | 1 October 2002 | 1 October 2005 | 1 October 2010 |
|---|---|---|---|---|
| Salt Slough and Wetland Water Supply Channels | **2 µg/L monthly mean** | | | |
| San Joaquin River below the Merced River; Above Normal and Wet Water Year types | | *5 µg/L monthly mean* | **5 µg/L 4-day avg.** | |
| San Joaquin River below the Merced River; Critical, Dry, and Below Normal Water Year types | | *8 µg/L monthly mean* | *5 µg/L monthly mean* | **5 µg/L 4-day avg.** |
| Mud Slough (north) and the San Joaquin River from Sack Dam to the Merced River. | | | | **5 µg/L 4-day avg.** |

[1] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level (Department of Water Resources Bulletin 120). The previous water year's classification will apply until an estimate is made of the current water year.

Table 6. Proposed Changes to the Control Actions Governing the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin Valley (Continued)

5. Waste discharge requirements may be used to control agricultural subsurface drainage discharges containing toxic trace elements, if water quality objectives are not continuously achieved beginning with the following dates:

January 1989 -- Molybdenum

~~October 1989 -- Selenium:~~
~~Water supply channels for Grassland Water District and State and federal refuges~~

October 1991 -- ~~Selenium and b~~Boron:
San Joaquin River, mouth of the Merced River to Vernalis

October 1993 -- ~~Selenium and b~~Boron:
Salt Slough, Mud Slough (north), and the San Joaquin River from Sack Dam to the mouth of the Merced River.

~~6. Milestones to the achievement of water quality objectives for selenium were used.~~

6. Selenium load reduction milestones will be incorporated into waste discharge requirements as effluent limits as necessary to ensure that:

a. the selenium water quality objective in the San Joaquin River downstream of the Merced River inflow is achieved.

b. Clean Water Act requirements for the implementation of a TMDL are satisfied.

7. Effluent limits established in waste discharge requirements will be applied to the discharge of subsurface drainage water from the Grassland watershed. In the absence of a regional entity to coordinate actions on the discharge, the Regional Board will consider setting effluent limits at each drainage water source (discharger) to ensure that beneficial uses are protected at all points downstream.

8~~1.~~ Upslope irrigations and water facility operators whose actions contribute to subsurface drainage flows will participate in the program to control discharges ~~beginning in January 1989.~~

~~9. The Regional Water Board staff will prepare a study plan that identifies the information needed to reconsider selenium and boron objectives.~~

9~~7.~~ Public and private managed-wetlands will participate in the program to achieve water quality objectives.

10. Meeting load reduction milestones is highly dependent upon the effectiveness of individual actions or technology not currently available; therefore, the Regional Board will review the waste discharge requirements and compliance schedule at least every 5 years.

11~~3.~~ ~~Annual submittal and approval of drainage operations plans (DOP) is required from~~ All those discharging or contributing to the generation of agricultural subsurface drainage ~~from 1989 through 1993.~~ will be required to submit for approval a short-term (5-year) drainage management plan designed to meet interim milestones and a long-term drainage management plan designed to meet final water quality objectives.

12. An annual review of the effectiveness of control actions taken will be conducted by those contributing to the generation of agricultural subsurface drainage.

Table 6. Proposed Changes to the Control Actions Governing the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin Valley (Continued)

| | |
|---|---|
| 13~~8.~~ | Evaporation basins in the San Joaquin Basin will be required to meet minimum design standards, have waste discharge requirements and be part of a regional plan to control agricultural subsurface drainage. |
| 14. | The Regional Board staff will coordinate with US EPA and the dischargers on a study plan to support the development of a site specific selenium water quality objective for the San Joaquin River and other effluent dominated waterbodies in the Grassland watershed. |
| 15~~2.~~ | The Regional Board will ~~reconsider site-specific water quality objectives for selenium and boron for Mud Slough (north), Salt Slough and the San Joaquin River, Sack Dam to Vernalis as needed and~~ establish water quality objectives for salinity for the San Joaquin River. ~~based upon the final Delta Plan that is approved by the State Water Board and USEPA.~~ |
| | ~~The Regional Water Board is currently in the process of updating and revising the implementation plan to control agricultural subsurface drainage.~~ |

In developing control actions for the Grassland watershed, the Regional Board recognizes that full attainment of beneficial use will not be possible for a considerable period of time. In developing the control actions for selenium, the Regional Board will utilize a priority system which focuses on a combination of sensitivity of the beneficial use to selenium and the amount of environmental benefit expected from the action. The most sensitive beneficial uses, those uses which are potentially impacted by selenium at a lower concentration, will be given first priority for protection. This is not intended to downplay the importance of any specific beneficial use, rather it is to focus resources on those actions expected to give the highest level of beneficial use improvement. Environmental benefit expected is measured in terms of miles and/or acres of surface water that will no longer be impacted.

The following goals for protecting beneficial uses in the Grassland Watershed and San Joaquin River are listed in order of priority. This priority list has been used to develop the control actions and timeable in the proposed amendment. Following the list is a discussion of the goals and how they will be achieved.

1) Attainment of the wildlife beneficial use to ensure protection of the wetlands within the Grassland watershed. Waterfowl and other aquatic organisms within a wetland environment are very sensitive to selenium and other toxic elements. Removal of selenium from this environment will enhance the full attainment of the wetland component of the wildlife beneficial use in the managed water channels used for a wetland environment.

2) Attainment of the aquatic life beneficial use potential in all channels used for wetland water supply within the Grassland watershed. A diversity of aquatic life in wetland supply channels will enhance the multiple use of these channels and enhance the diversity of aquatic life finding their way into the wetland

3) Attainment of the aquatic life beneficial use in the San Joaquin River downstream of the Merced River. The San Joaquin River downstream of the Merced River is a natural flowing stream with a diversity of beneficial uses that are critical to beneficial use attainment in the Delta. Aquatic life beneficial uses are sensitive to the selenium that is discharged with the agricultural subsurface drainage.

4) Attainment of the appropriate aquatic life beneficial use in the effluent-dominated natural channels of the Grassland watershed and full aquatic life protection in the San Joaquin River upstream of the Merced River inflow

*Protection of Wetlands Within the Grasslands Watershed*

Wetlands protection was given a high priority for the Grassland watershed by the San Joaquin Valley Drainage Program Implementation Plan. One of the primary reasons for the high priority was the sensitivity of waterfowl and aquatic organisms to selenium buildup within a wetland system. The wetlands within the Grassland watershed are also recognized as being of special significance to the Pacific Flyway and must therefore be given a high level of protection.

The present wetland water supply system is a series of constructed channels that are shared as a conveyance system for both wetland water supplies and discharge of selenium-laden agricultural drainage from upslope lands. This combined use results in sub-optimal wetland management and can cause elevated selenium concentrations in wetland supply water. Previously in the Basin Plan, protection of the wetland water supply was assumed to occur through an increased level of management of the joint conveyance system. The risk of beneficial use impairment has been increased by the recent provision of additional water supplies for the wetlands as recommended by the San Joaquin Valley Drainage Program Report (SJVDP, 1990a). Management as a joint conveyance system is no longer a satisfactory approach to beneficial use protection for the wetlands.

Because of the high selenium levels in the agricultural subsurface drainage water, the only way currently available to eliminate the risk of wildlife beneficial use impairment is to remove the drainage from the wetland water supply channels. The San Joaquin Valley Drainage Program Implementation Plan (SJVDP, 1990a) recommended that the selenium-laden drainage water be removed from the wetland water supply channels and be conveyed around the entire wetland area using a portion of the former San Luis Drain. The districts in the Drainage Problem Area, operating through a regional entity, have proposed the implementation of a Grassland bypass (USBR, 1995a). The Grassland bypass would remove the drainage from wetland supply channels and convey the selenium-laden drainage to Mud Slough (north) using the recommended portion of the former San Luis Drain. Implementation of this project would remove agricultural subsurface drainage from Salt Slough and all the wetland supply channels identified in Appendix 1.

The plan to implement a Grassland bypass, as proposed by the districts in the Drainage Problem Area and the wildlife managers in the Grassland watershed is financially feasible. Due to the availability of a feasible proposal and the need for increased wetlands and wetland water supply protection, the proposed basin plan amendment prohibits the discharge of agricultural subsurface drainage water to Salt Slough and wetland water supply channels identified in Appendix 1 after

1 October 1996 unless water quality objectives are being met. This prohibition should protect wetlands in the Grassland Watershed from elevated selenium concentrations.

*Aquatic Life Protection in Wetland Water Supply Channels*

Wetlands protection was given a high priority for the Grassland watershed by the San Joaquin Valley Drainage Program Implementation Plan. Because the wetland channels are an integral part of the wetlands within the Grassland watershed, similar protection must be afforded these channels. As discussed under wetlands protection above, the present water supply channels carry both wetland water supplies and agricultural subsurface drainage. The proposed wetlands bypass discussed above, would remove the selenium-laden drainage water from these channels. The steps taken to provide protection of the wetlands water supply for wildlife beneficial use designations should be adequate to enable full aquatic life beneficial use protection in the channels with respect to selenium levels. The prohibition of discharge after 1 October 1996 of agricultural subsurface drainage water to wetland supply channels identified in Appendix 1 should be adequate to provide aquatic life protection in these same channels.

*Aquatic Life Protection in the San Joaquin River Downstream of the Merced River Inflow*

The third priority for beneficial use protection focuses on aquatic life in the San Joaquin River downstream of the Merced River inflow. Selenium data collected by the Regional Board and other agencies indicates that the proposed 5 $\mu$g/L 4-day average selenium water quality objective for aquatic life protection is being exceeded in the San Joaquin River downstream of the Merced River.

The San Joaquin Valley Drainage Program (SJVDP, 1990a) analysis showed that aquatic life in the San Joaquin River downstream of the Merced River could only be protected by reducing the total load of selenium discharged. An analysis of historical selenium loads from the Drainage Problem Area indicates that reductions in the selenium load results in water quality improvements in the San Joaquin River downstream of the Merced River (Chilcott, et al., 1995; Vargas, et al., 1995). A program to accomplish water quality improvements and load reductions will be complicated and may take a considerable period of time to fully implement, since many of the control actions to reduce drainage that were recommended by the SJVDP are not currently available.

Since actions to accomplish water quality improvements and load reductions may take time to implement, the first step is to ensure that actions taken in the Grassland watershed do not degrade water quality downstream in the San Joaquin River. The actions required to protect wetland resources and wetland channels are simply a rerouting and increased management of drainage flows as they move through the Grassland watershed to a discharge point on the San Joaquin River. Data collected since 1985 shows that a larger selenium load is discharged from the Drainage Problem Area than is eventually discharged to the San Joaquin River. Therefore, the rerouting carries the risk that selenium loading to the San Joaquin River could increase as a tradeoff for the improvements gained within the Grassland watershed. Since it is not clear whether the 20% average historical loss of selenium through the Grassland watershed will continue with use of the wetlands bypass, any load reductions must be based on the amount of selenium that was actually reaching the river rather than the load discharged from the Drainage Problem Area.

To ensure that water quality is maintained in conformance with Water Code Section 12232, implementation actions must be focused on no increase in the annual load discharged to the San Joaquin River. The actions needed are:

a) A prohibition of discharge of subsurface drainage to the San Joaquin River or tributaries from any tile or open drainage system unless such discharge began prior to the effective date of this amendment or the discharge is governed by waste discharge requirements. This prohibition would apply to the entire Grassland watershed and would apply to systems installed to lower the water table in irrigated agricultural land. The prohibition would ensure that new subsurface drainage discharges would not increase the total load discharged to the River, while others are expending considerable resources to reduce loads. This prohibition would also help ensure that the total annual load of selenium does not increase over that which was previously discharged to the San Joaquin River.

b) A prohibition of discharge of selenium from agricultural subsurface drainage systems in the Grassland watershed in amounts that exceed 8,000 lbs/year. Based on estimates made for the 1975-1985 time period and available data from the 1985-1994 time period, this annual limit reflects the maximum selenium load from the Grassland watershed discharged into the San Joaquin River. This load limit should be effective beginning 1 October 1996 and measured on a water year time schedule (from 1 October through 30 September).

The load limit proposed is not based on the selenium load that was discharged directly from the Drainage Problem Area into the wetland supply channels (which is greater than the load discharged from the watershed into the San Joaquin River). By basing the load limit on the selenium load that actually entered the San Joaquin River historically, further degradation of the San Joaquin River will not occur. If the 20 percent selenium load reduction that historically occurred between the Drainage Problem Area and the San Joaquin River, does not occur with use of the Grassland bypass, it will be the responsibility of the dischargers to take additional steps to reduce selenium loads, to meet proposed limits.

The second step to ensure aquatic life protection in the San Joaquin River is to begin a program to meet water quality objectives through selenium load reductions. To assess the amount of selenium load reduction required, a method was developed to determine the assimilative capacity of the San Joaquin River downstream of the Merced River depending on water-year type and season. Monthly load allocations from the Drainage Problem Area were then determined based on the water quality objective and applicable performance goals.

For a 5 $\mu$g/L, 4-day average selenium objective and a one in three year exceedance rate[5], an 80% reduction in annual load would be required in dry years and a 47% reduction in annual load would

[5] The U.S. EPA allows a one in three year violation rate of water quality standards.

be required in wet years[6]. In addition to load reductions, adjustments in the timing of discharge will be needed. The estimated percent load reductions that must occur within each month to meet a 5 $\mu g/L$ 4-day average water quality objective for selenium are shown in Table 7.

Possible actions which could lead to load reductions were analyzed in detail by the State Water Board San Joaquin River Technical Committee (SWRCB, 1987), the San Joaquin Valley Drainage Program (SJVDP, 1990a), and the San Luis Unit Drainage Program (USBR, 1991a, 1991b). Several of the actions that had a high potential to reduce loads were evaluated to make a preliminary estimate of the feasibility of meeting selenium load targets. This evaluation and the assumptions used are described in Appendix 3. Given the assumptions used on the effectiveness of the actions, it appears that the necessary load reductions should be technically achievable.

The analysis in Appendix 3 shows that the needed load reductions are possible, but there is still a large uncertainty on the effectiveness of each action, the time period needed to observe a reduction and what optimum mix of actions is best in terms of environmental effectiveness and minimization of cost. Because of this uncertainty, the regulatory program must be conducted as a series of short-term actions that are designed to meet a long-term goal. The implementation strategy must establish a firm final goal of meeting water quality objectives with enforceable interim milestones to measure progress. The uncertainty of load reduction technology also makes it necessary to review the implementation mechanism frequently and provide the dischargers in the Drainage Problem Area with the incentive to meet water quality goals. The dischargers should be allowed the flexibility to determine the most cost effective method or methods of meeting those goals.

The Regional Board previously used regulatory encouragement of BMPs through the adoption of water quality objectives. This approach was consistent with the State Water Board Non-point Source Management Plan. This approach, however, did not result in attainment of water quality objectives. Load reductions appear necessary to meet the present water quality objectives. Therefore, the use of waste discharge requirements (WDRs) is proposed. These WDRs would incorporate load reduction milestones to achieve water quality objectives. The incorporation of load reduction milestones into WDRs would provide the dischargers with the incentive to implement control actions and also provide the Regional Board with the flexibility to adjust the milestones based on the success of the control actions. The best mix of BMPs should be left to the dischargers.

For the first five years, the WDRs would utilize monthly waste load allocations agreed to by the dischargers, USEPA, USFWS, and USBR as effluent limits (Consensus, 1995). After the initial five years, effluent limits would be developed using the Total Maximum Monthly Load Model (TMML) which is discussed in detail in the next section.

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[6] The percent load reduction is based on the historical average (water years 1986-1994). The 1986-1994 time period was used in establishing effluent limits for the Grassland Bypass Channel (USBR, 1995a).

**Table 7 Estimated Percentage Change in Selenium Load in the San Joaquin River Downstream of the Mercer River within Each Month for Various Water Year Types to Meet a 5 μg/L 4-day Average Selenium Water Quality Objective Based on One in Three Year Exceedance Rate[1]**

| Month | Water Year Type | |
|---|---|---|
| | AN/W | C/D/BN |
| January | -60% | -75% |
| February | -66% | -89% |
| March | -72% | -91% |
| April | -61% | -87% |
| May | -51% | -83% |
| June | -65% | -90% |
| July | -65% | -89% |
| August | -58% | -87% |
| September | -15% | -86% |
| October | +56% | -76% |
| November | +23% | -81% |
| December | -28% | -56% |

[1] Percent change in average load levels in Mud Slough (n) and Salt Slough: 1986-1994.
C = Critically Dry; D = Dry; BN = Below Normal;
AN = Above Normal; W = Wet

The effluent limits established in WDRs should be applied as a watershed goal rather than applied to individual districts or dischargers. In order to implement this action, the individual dischargers need to establish a regional entity to coordinate actions on the WDR and for development of a regional plan for selenium load reductions. In the absence of a regional entity, the Regional Board would consider establishing water quality and load limitations at each district outfall. In the absence of a regional entity, the Regional Board will not know how water will be transported within and through the Grassland watershed, therefore, the effluent limits would reflect the receiving water objectives to ensure that water quality objectives are met at all points downstream.

Although the evaluation in Appendix 3 shows that load reductions can be achieved on a watershed basis, implementation of the actions to meet the load reduction targets will take time. The San Joaquin Valley Drainage Program Final Report (SJVDP, 1990a) envisioned full implementation over a 50-year period. Constraints to a faster implementation schedule are that many of the actions evaluated in Appendix 3 and recommended by the San Joaquin Valley Drainage Program are in a research and development stage or the exact impact of the action in the Grassland watershed is not known. Despite these limitations, the program for protection of aquatic life in the San Joaquin River downstream of the Merced River inflow needs to proceed as quickly as possible. Development and evaluation of control actions can be enhanced by:

a) use of a regional or watershed approach to ensure rapid development of the needed implementation actions;

b) use of a regional or watershed entity to ensure smooth implementation of the needed actions; and

c) establishment of interim goals to measure and encourage progress toward improving water quality.

Given the uncertainty in the effectiveness of possible load reduction alternatives and the time lag between implementation and effect, a 10-year time schedule is proposed for meeting the 5 $\mu$g/L 4-day average water quality objective for selenium for wet water year types and a 15-year time schedule is proposed for meeting this objective for dry water year types. Performance goals will be established effective no later than 1 October 2002. Prior to the performance goals, load limitations will be used to improve water quality. These performance goals reflect the previous Regional Board adopted selenium water quality objectives (5 µg/L monthly mean for wet years and 8 µg/L monthly mean for dry years). The dry year performance goal will be decreased to a 5 µg/L monthly mean and will be effective no later than 1 October 2005 (Table 8).

In addition to the 8,000 lb/year selenium load cap that applies every water year beginning 1 October 1996, waste discharge requirements would incorporate load reduction milestones to achieve water quality objectives. The final load target established in the waste discharge requirements should be consistent with the requirements of the Clean Water Act for the implementation of a TMDL (Section 303(d)).

In a prior Regional Board report (Karkoski, 1994), staff developed a methodology to determine the Total Maximum Monthly Load (TMML) for selenium in the San Joaquin River. Staff is recommending that a phase 1 TMML be submitted to the U.S. EPA (Appendix 4) for approval upon adoption of the Basin Plan by the Regional Board. The proposed TMML would be used to develop selenium effluent limits for incorporation into WDRs. The proposed TMML submittal is discussed at length in a subsequent section.

Review of effluent limits in the WDRs should take place at least every five years. The first review will occur no later than March 2000. This review will allow the Regional Board, the dischargers and others to assess the progress made in implementation of control actions and the effectiveness of those control actions. Development of a waste discharge requirement that would be reviewed every five years would provide the mechanism for adjustments and allow for any needed changes in effluent limits as technology improves or experience is gained. The review of the initial five-year target should focus on the implementation of control actions that are currently available.

The Regional Board recognizes that meeting the 10-year time schedule for wet water years and 15-year time schedule for dry water years is highly dependent on the effectiveness of control actions that are not currently available. Therefore, a review of the Regional Board implementation plan for subsurface drainage should take place at least every five years. The

### Table 8 SUMMARY OF SELENIUM WATER QUALITY OBJECTIVES AND COMPLIANCE TIME SCHEDULE

**Selenium Water Quality Objectives (in bold) and Performance Goals (in italics)**

| | Applies no Later Than | | | |
|---|---|---|---|---|
| Water Body/Year Type[1] | 1 October 1996 | 1 October 2002 | 1 October 2005 | 1 October 2010 |
| Salt Slough and Wetland Water Supply Channels | **2 µg/L monthly mean** | | | |
| San Joaquin River below the Merced River; Above Normal and Wet Water Year types[1] | | *5 µg/L monthly mean* | **5 µg/L 4-day avg.** | |
| San Joaquin River below the Merced River; Critical, Dry, and Below Normal Water Year types | | *8 µg/L monthly mean* | *5 µg/L monthly mean* | **5 µg/L 4-day avg.** |
| San Joaquin River above the Merced River and Mud Slough (north) | | | | **5 µg/L 4-day avg.** |

[1] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level (Department of Water Resources Bulletin 120). The previous water year's classification will apply until an estimate is made of the current water year.

appropriateness of the implementation plan, the effectiveness of actions taken by the districts and the costs of those actions should be part of an evaluation process. To facilitate an evaluation of the WDRs and the Basin Plan, a short-term (five-year) and long-term (fifteen-year) drainage management plan should be developed by the entity or entities governed by WDRs. The initial short-term plan should be developed and submitted for approval to the Regional Board within one year of approval of this Basin Plan Amendment. The short-term plan should detail a time schedule for implementation of specific actions, estimated cost, and estimated load reduction that can be achieved. An annual evaluation of this management plan should be provided in a report to the Regional Board that describes actions taken in the previous year, costs incurred and the effectiveness of the control actions.

The long-term plan should outline the methods to be used to meet final water quality objectives, define research and development needs and how those needs will be met. The long-term plan should also provide initial cost estimates and a tentative implementation schedule. The long-term plan should be prepared and approved by the Regional Board within two years of the final approval of this Basin Plan amendment.

*Aquatic Life Protection in Mud Slough (north) and the San Joaquin River from Sack Dam to the Merced River Inflow*

The wetlands protection provided by the proposed prohibition of subsurface discharge in selected water bodies will result in water quality improvements in wetland channels and will also result in water quality improvements in Salt Slough and the San Joaquin River from the Salt Slough inflow to the Mud Slough (north) inflow. These improvements will result in wetlands protection and aquatic life protection. The prohibitions are expected to produce a change in drainage flow management such that water quality impacts will continue in Mud Slough (north) and the San Joaquin River from the Mud Slough (north) inflow downstream to the Merced River inflow for a maximum of 15 years. The immediate effects of the change in drainage flow management will be:

a) Improved water quality in Salt Slough and the San Joaquin River from the Salt Slough inflow downstream to the Mud Slough (north) inflow; and

b) Improved water quality in all the wetland water supply channels of the Grassland watershed.

In addition, load reduction of selenium in the discharge into Mud Slough (north) that is required to protect aquatic life in the San Joaquin River downstream of the Merced River inflow will be implemented incrementally over a 15-year time period (see previous discussion).

The San Joaquin Valley Drainage Program Management Plan (SJVDP, 1990a) recognized that protection of aquatic life in Mud Slough (north) and the San Joaquin River from the Mud Slough (north) inflow to the Merced River inflow could only be accomplished by removing the drainage water from these channels. The plan recommended an extension of the Grassland bypass to a discharge point on the San Joaquin River downstream of the Merced River inflow. This would remove the drainage water from the effluent dominated channels and result in compliance with selenium water quality objectives.

The San Luis Unit Drainage Program (USBR, 1991a, 1991b) estimated the cost (1990 dollars) of extending the wetlands bypass to a point on the San Joaquin River downstream of the Merced River inflow to be from $16-$28 million dollars. To the extent that efforts to achieve load reductions lead to reductions in drainage volume, the construction cost of the Grassland bypass extension could also be reduced.

The proposed compliance date for meeting the selenium water quality objective in Mud Slough (north) and the San Joaquin River from the Mud Slough (north) inflow to the Merced River inflow is October 1, 2010. This compliance date is established based on the listing of priorities established for beneficial use enhancement. It is recognized that Mud Slough (north) and the San Joaquin River downstream of Mud Slough (north) to the Merced River inflow will continue to experience water quality impacts for an extended period of time. These impacts are only tolerable as long as progress is being made on load reductions to achieve water quality objectives in the San Joaquin River downstream of the Merced River inflow; and compliance with water quality objectives in Salt Slough and the wetland water supply channels continues. In the event that progress is not being made, the Board needs to consider whether a prohibition of discharge is needed for these effluent-dominated channels prior to the compliance date. A prohibition will be the mechanism used to ensure compliance after October 1, 2010.

**PROPOSED TOTAL MAXIMUM DAILY LOAD (TMDL) SUBMITTAL TO THE U.S. EPA**

Section 303(d) of the Federal Clean Water Act requires the development of a TMDL where existing effluent limitations are not stringent enough to meet water quality standards. The code of Federal Regulations (40 CFR Chapter 1, Section 130.7) describes the process for submittal of a TMDL to the U.S. EPA. The Regional Board has identified the San Joaquin River as a water quality limited segment with respect to selenium. The Regional Board has also given priority to development of a selenium TMDL for the San Joaquin River.

Two technical reports were used as the basis for determining the Total Maximum Monthly Load (TMML) for meeting selenium objectives in the San Joaquin River downstream of the Merced River (Karkoski, et al, 1993; Karkoski, 1994). The 1993 paper was peer reviewed for a conference sponsored by the American Society of Civil Engineers. The 1994 Regional Board technical report was peer reviewed by representatives of the Regional Board, U.S. EPA (Region IX and headquarters), the Environmental Defense Fund, Lawrence Berkeley Laboratories, U.S. Geological Survey, and Cornell University.

The TMML is the total load that the San Joaquin River can assimilate without exceeding the applicable water quality objective at a specified frequency. The U.S. EPA allows violations of standards at a frequency of no greater than once every three years. The TMML is apportioned among background sources of selenium (wetlands, the Merced River, and the San Joaquin River above Salt Slough), a margin of safety (established as 10% of the TMML) and a waste load allocation (discharges from the Drainage Problem Area). The final recommended effluent limits are based on the calculated waste load allocation to meet the proposed water quality objective of 5 $\mu$g/L (4-day average). The interim effluent limits which would apply through September 30, 2000, are adapted from the consensus letter written to the Regional Board from the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and San Luis Delta-Mendota Water Authority (Consensus, 1995). Interim effluent limits which would apply thereafter are based on meeting proposed performance goals outlined in Table 4 of this report. The monthly effluent limits recommended by the consensus letter vary by month, but do not differentiate between water year types and covers the time period of October 1995 through September 2000. The monthly effluent limits based on the performance goals and water quality objectives vary by water year type and would be effective after September 2000. The recommended interim and final effluent limits are given in Tables 9, 10a and 10b. Table 9 presents the recommended effluent limits are from the consensus letter. Table 10a presents the effluent limits required to meet applicable performance goals and water quality objectives in dry years. Table 10b presents the effluent limits required to meet applicable performance goals and water quality objectives in wet years.

Staff is recommending that the effluent limits in Tables 9, 10a, and 10b be incorporated into waste discharge requirements in support of water quality objectives and performance goals. These limits will be submitted to the U.S. EPA as a phase 1 TMDL for selenium in the San Joaquin River. The effluent limits will be submitted to the U.S. EPA for approval by the executive officer of the Central Valley Regional Board upon adoption of the proposed Basin Plan Amendment by the Regional Board. A draft letter to the U.S. EPA is included in Appendix 4.

Both the interim and final effluent limits (presented in Tables 10a and 10b) were based on a twenty-two year period of record (1970-1991) for the San Joaquin River at Crows Landing. These targets could change depending on the outcome of the Bay-Delta water rights decision. If seasonal flow patterns are altered significantly in the Merced River and/or the San Joaquin River upstream of the Merced River confluence, the monthly effluent limits would need to be adjusted to reflect the changes in assimilative capacity. It would be inappropriate to base the waste load allocation on historical flow patterns if significant alterations in that flow pattern take place. Additionally, staff will likely update the period of record upon which the effluent limits are based to include 1992-1995.

For the reasons stated above, the executive officer may submit an amended TMDL to USEPA during the proceedings to adopt waste discharge requirements for agricultural subsurface drainage discharges in the Drainage Problem Area. The Regional Board has also developed a comprehensive monitoring program in the Grassland watershed and San Joaquin River. The data collected as a part of the monitoring program will be used to determine the appropriateness of the TMDL submitted to the U.S. EPA. Formal data assessment and TMDL validation will take place at least once every five years. Further model development may be required depending on the outcome of the data assessment and TMDL validation.

**Table 9**
**Monthly Waste Load Allocation (pounds of selenium) for the Drainage Problem Area Based on the Consensus Letter (Consensus, 1995)**

| Month | Effluent Limits which apply 10/95-9/97 | Effluent Limits which apply 10/97-9/98 | Effluent Limits which apply 10/98-9/99 | Effluent Limits which apply 10/99-9/00 |
|---|---|---|---|---|
| October | 348 | 348 | 348 | 348 |
| November | 348 | 348 | 348 | 348 |
| December | 389 | 389 | 389 | 389 |
| January | 533 | 506 | 479 | 453 |
| February | 866 | 823 | 779 | 736 |
| March | 1066 | 1013 | 959 | 906 |
| April | 799 | 759 | 719 | 679 |
| May | 666 | 633 | 599 | 566 |
| June | 599 | 569 | 539 | 509 |
| July | 599 | 569 | 539 | 509 |
| August | 533 | 506 | 480 | 453 |
| September | 350 | 350 | 350 | 350 |
| Max. Annual | 6660 | 6327 | 5994 | 5661 |

**Monthly Waste Load Allocation (pounds of selenium) for the Drainage Problem Area Based on Applicable Performance Goals and a 5 $\mu$g/L 4-day Average Selenium Objective for the San Joaquin River at Crows Landing**

**Table 10a Dry Year (C/D/BN)[1] Monthly Load Allocations**

| Month | Effluent Limits which apply no later than 1 October 2002 | Effluent Limits which apply no later than 1 October 2005 | Effluent Limits which apply no later than 1 October 2010 |
|---|---|---|---|
| October | 114 | 69 | 41 |
| November | 114 | 69 | 41 |
| December | 303 | 186 | 131 |
| January | 302 | 186 | 131 |
| February | 284 | 169 | 99 |
| March | 284 | 169 | 98 |
| April | 293 | 178 | 107 |
| May | 296 | 181 | 111 |
| June | 126 | 76 | 64 |
| July | 127 | 77 | 65 |
| August | 132 | 83 | 70 |
| September | 116 | 71 | 43 |
| Total | 2,492 | 1,515 | 1,001 |

**Table 10b Wet Year (AN/W) Monthly Load Allocations**

| Month | Effluent Limits which apply no later than 1 October 2002 | Effluent Limits which apply no later than 1 October 2005 |
|---|---|---|
| October | 328 | 260 |
| November | 328 | 260 |
| December | 461 | 211 |
| January | 461 | 211 |
| February | 432 | 297 |
| March | 432 | 297 |
| April | 450 | 315 |
| May | 457 | 322 |
| June | 262 | 212 |
| July | 264 | 214 |
| August | 274 | 225 |
| September | 332 | 264 |
| Total | 4,481 | 3,087 |

C = Critically Dry; D = Dry; BN = Below Normal; AN = Above Normal; W = Wet

[1] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level (Department of Water Resources Bulletin 120). The previous year's classification will apply until an estimate is made of the current water year.

## ESTIMATED COSTS AND POTENTIAL FUNDING SOURCES

The San Joaquin Valley Drainage Program (SJVDP, 1990a) Final Report assumed a 5 $\mu$g/L selenium monthly mean water quality objective when the SJVDP developed alternatives for the 90,000 acre Drainage Problem Area. The cost estimate for implementation of the Grassland bypass was $30/acre/year and the implementation program of drainage reduction alternatives was $81/acre/year (1990 dollars). Costs may be higher to achieve the proposed 5 $\mu$g/L 4-day average water quality objective for selenium which is currently proposed.

Comments were provided by the San Luis & Delta-Mendota Water Authority (SLDMWA) on the annual reduction in economic activity if the alternatives discussed in Appendix 3 were implemented (SLDMWA, 1995). Their estimate of reduction in economic activity was between $90-$180/acre/year. This estimate included reduction in household income and reduction in revenue of supporting industries.

The SLDMWA also estimated the impact in the next five years if recirculation and improved irrigation were used as the sole means for meeting load targets. They estimated that economic activity would be reduced by $304/acre/year. The State Water Resources Control Board provided an analysis of the economic report used by the SLDMWA in developing their comments (Appendix 5). The major finding of the State Water Board analysis was that a complete answer to the question of the economic impact of reducing selenium discharges was not provided by SLDMWA. The major limitation, according to the State Water Board analysis, was that the economic model used by the SLDMWA models district-wide impacts rather than examining variations in cost on a field by field basis. "Costs are likely to be lower if acreage generating high selenium loads were fallowed or managed more intensively" (from Appendix 5).

The Environmental Defense Fund (EDF) performed an evaluation of the most economically efficient method of meeting water quality objectives in the San Joaquin River downstream of the Merced River (EDF, 1994). The EDF report found that a program of tradeable discharge permits was a least cost method for meeting water quality goals versus a mandated Best Management Practice Program. The EDF report looked solely at meeting load limits through on-farm irrigation improvements with recirculation required in critical water years.

Based on the cost estimates in the report, the incremental increase in the cost of irrigation would be $40/acre/year or $3.6 million/year in the Drainage Problem Area (1990 dollars). This estimate does not include the cost of the recirculation systems.

Implementing a Grassland bypass to the San Joaquin River downstream of the Merced River concurrently with significant load reductions will be difficult from an economic stand point. Success in accomplishing both goals (load reduction and protection of Mud Slough (north)) will depend on the aggressive development and implementation of cost effective load reduction technologies. Depending on the cost of load reduction technologies, an extension of the Grassland bypass may require financing from sources outside of the Drainage Problem Area.

The suggested changes to the portion of the Basin Plan that discusses costs and sources of funding for the agricultural subsurface drainage control program are presented in Part II of this report under "Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing.

# PART VI SURVEILLANCE AND MONITORING

The following section contains a description of the monitoring and surveillance activities to be undertaken by the Regional Board, the dischargers and others. These monitoring activities are presented in Part II of this report under "Surveillance and Monitoring".

The protection, attainment, and maintenance of beneficial uses occur as part of a continuing cycle of identifying beneficial use impairments, applying control measures, and assessing program effectiveness.

Monitoring and surveillance includes monitoring done by the dischargers, monitoring and investigations done by the Regional Board and surveillance and inspections done by the Regional Board. Acquisition of data is a basic need of a water quality control program and is required by both the Federal Clean Water Act and the Porter-Cologne Water Quality Control Act.

The Regional Board surveillance and monitoring program provides for the collection, analysis, and distribution of the water quality data needed to sustain its control program. Under ideal circumstances, the Regional Board surveillance and monitoring program would produce information on the frequency, duration, source, extent, and severity of beneficial use impairments. In attempting to meet this goal, the Regional Board relies upon a variety of measures to obtain information.

## PROPOSED ACTIVITIES

### Discharger Monitoring

The Regional Board relies on data collected by a variety of other agencies. For example, DWR has an ongoing monitoring program in the Delta and the United States Geological Survey (USGS) and DWR conduct monitoring in some upstream rivers. The Department of Fish and Game, Fish and Wildlife Service, USGS, and Department of Health Services also conduct special studies and collect data. The Regional Board participates in the selection of sampling sites for its basins and is provided with an annual report of the testing results.

Most of the dischargers of agricultural subsurface drainage on the west side of the San Joaquin basin are already monitoring their discharges under Regional Board required Monitoring and Reporting Program No. SJR001 and have since 1985. Some dischargers were monitoring on their own before 1985.

In general, monitoring programs operated by the local agencies (dischargers) have had a local focus. Local level monitoring has included drainage sumps, internal drains, discharge points and some receiving waters. The emphasis on local monitoring will continue to ensure that the dischargers develop a reliable database from which management decisions can be made.

In addition to the traditional monitoring of discharges and receiving waters, the Regional Board will request that irrigation, drainage and water districts work with Regional Board staff in compiling information on the efforts made to reduce the generation of subsurface drainage. The focus of this effort during the next five years will be on determining actual drainage flows as related to water application management, with an emphasis on pre-irrigation activities. In cooperation, the dischargers and Regional Board staff will assess information on irrigation efficiency improvements and on seepage control improvements.

The information will include:

- Types of irrigation systems and management techniques employed;
- Effectiveness of reducing deep percolation and drain flows;
- Determine the extent and amount of tile drain water reuse possible;
- Determine what impact the reuse of tile drain water has on loads and the need for increased leaching;
- Determine the amount of well water used for irrigation on farm & district wide;
- Determine what impact the use of well water has on long term soil condition, leaching and loads and;
- Costs and benefits of improved irrigation efficiency.

**Regional Board Monitoring**

The Regional Board has been monitoring discharges of agricultural subsurface drainage, the San Joaquin River and its tributaries for the constituents in agricultural subsurface drainage since 1985. The Regional Board with the cooperation of local agencies has conducted synoptic sampling of subsurface drainage facilities discharges (tile drain sumps) on several occasions. In addition, the Regional Board has done several investigations to locate and define sources of toxic trace elements associated with agricultural wastewater discharges, the concentration and location of subsurface drainage toxic trace elements in surface waters, and the methods of transport and sinks of agricultural subsurface drainage constituents.

**Regional Board Surveillance and Inspection**

Regional Board surveillance and inspection activities will include the following:

1. The Regional Board will inspect discharge flow monitoring facilities and will continue its cooperative effort with dischargers to ensure the quality of laboratory results of sampling.

2. The Regional Board will, on a regular basis, inspect any facilities constructed to store or treat agricultural subsurface drainage.

3. The Regional Board will continue to maintain and update its information on agricultural subsurface drainage facilities in the Grassland watershed. Efforts at collecting basic data on all facilities, including flow estimates and water quality will continue.

4. As water conservation is likely to play an important part in efforts to meet water quality objectives, the Regional Board, in cooperation with other agencies, will regularly assess water conservation achievements and compile cost and drainage reduction effectiveness information. In addition, in cooperation with the programs of other agencies and local district managers, the Regional Board will gather information on irrigation practices, i.e., irrigation efficiency, excessive deep percolation and on seepage losses, (types, numbers, length of canals and ditches, etc.), use of facilities, and typical seepage rates.

**Aerial Surveillance**

Low-altitude flights are conducted primarily to observe variations in field conditions, gather photographic records of discharges, and document variations in water quality.

**Compliance Monitoring**

Compliance monitoring determines permit compliance, validates self-monitoring reports, and provides support for enforcement actions. Discharger compliance monitoring and enforcement actions are the responsibility of the Regional Board staff.

**Complaint Investigations**

Complaints from the public or governmental agencies regarding the discharge of pollutants or creation of nuisance conditions are investigated and pertinent information collected.

## FUTURE STUDIES

Intensive water quality studies provide detailed data to locate and evaluate violations of receiving water standards and to make load allocations. They usually involve localized, frequent and/or continuous sampling. These studies are specially designed to evaluate problems in potential water quality limited segments, areas of special biological significance or hydrologic units requiring sampling in addition to the routine collection efforts.

In 1985, little was known about the location and concentrations of selenium, molybdenum and other trace elements and toxics that occur in subsurface agricultural drainage water. In a short period of ten years, a great deal of insight has been gained. Based on this insight, it does not appear that the load reductions necessary to meet water quality objectives can be accomplished by water conservation or other BMPs.

Many informational needs remain. Information is needed to refine water quality objectives and the Regional Board regulatory program. Information about means of achieving water quality objectives and complying with the requirements of the Regional Board implementation program is also needed. In addition, the information about practical means of reducing drainage flows needs to be transferred to the farmer level.

Several studies should be undertaken to meet these needs. These studies include:

1. Development of a regional ground water model. The drainage problem in the Grassland Basin of the San Joaquin River Basin is a shallow ground water management issue. The impacts of certain practices are not fully understood. There is a need to complete development of a watershed ground water model. The USGS has started initial efforts on a Regional Ground Water Model for the entire San Luis Service Area and the San Joaquin Valley Drainage Program for the Grassland Area. Higher priority in funding needs to be directed at developing and completing a more intensive model for the Drainage Problem Area, which presently discharges through the Grassland area.

2. An assessment of the efficacy and the cost and benefits of actions taken by dischargers to meet the water quality objectives.

3. Site-specific data on the impact of trace elements in subsurface agricultural drainage is lacking. Continuing issues are:

    a. An assessment of the existing condition of the fish, biota and food chain items in the San Joaquin River and Mud and Salt Sloughs;

    b. A determination of the impacts of changes in water quality on the fish, biota, and food chain items in the San Joaquin River and Mud and Salt Sloughs;

4. Development of drainage reduction technology and transfer to the farmer level. The biggest unknown in utilizing water management to implement load reductions are whether or not the available technology will work, the effectiveness of this technology, and which parts of that technology are best developed and implemented in the

Drainage Problem Area. These concerns are most effectively answered using a multi disciplined effort to develop information about drainage reduction technology and transfer this information to the farm level. Several existing mechanisms are available for development of the technology (USDA-ARS, UC System Coop Extension and private efforts) and its transfer (UC Coop Extension, USDA, SCS, local water agencies and private efforts). The role of the Regional Board should be to encourage and support these efforts.

5. Regional watershed storage of salt and other watershed drainage solutions need to be studied to determine their risk as compared with the risk or cost associated with continued use of the San Joaquin River as an outlet. The Regional Board should provide support to agencies attempting to find grant funds for these studies and as available, allocate resources to determine whether these solutions are applicable in the watershed and whether interim sites should be tested.

6. Studies on the use of a valley wide drain to carry salts generated by agricultural irrigation out of the valley should be continued as the only feasible, long-range solution for achieving a salt balance in the Grassland watershed and in the Central Valley.

7. Study the effect that well water and the reuse of tile drain water have on decreased soil quality, i.e., increased salt and boron concentration, reduced yield, and increased use of Delta water for leaching and subsequent increased drain water volume and loads.

8. Load monitoring studies to establish effectiveness of control measures for toxic trace elements and salinity and boron. These studies should focus on establishing cause-and-effect relationships.

9. Studies to identify the impact of up slope contributions to subsurface drainage facilities. While the exact quantification of volumes and pollutant loads from individual up slope irrigators is not possible at this time, basic information, i.e., estimates of volume and impact of quality, about the collective impact of up slope irrigation on specific facilities should be studied. The role of the Regional Board should be to encourage and support these efforts.

These studies have been presented here to recognize limitations in the current database. The studies are not proposed for incorporation into the basin plan.

# PART VII CEQA REVIEW

The Secretary of Resources has certified the Basin Planning process as meeting the requirements of Section 21080.5 of the California Environmental Quality Act (CEQA). As such, documents prepared in connection with the basin plan amendment may be submitted in lieu of an environmental impact report. These documents must include either alternatives to the activity and mitigation measures to reduce any significant or potentially significant effect that the project may have on the environment or a statement that the project would not have a significant impact on the environment. This statement must be supported by a checklist or other documentation which shows the possible effects that were considered when reaching this decision.

The attached checklist was prepared in compliance with this requirement and to assist in identifying potential impacts and outlining mitigation measures. Each finding of the checklist has been supported by a statement of fact and/or data. Where available other reports, which address the issue in question, have been referenced.

## ENVIRONMENTAL CHECKLIST FORM

1. **Project Title:** Amendment to the Water Quality Control Plan for the San Joaquin River Basin - Regulation of Agricultural Subsurface Drainage in the Grassland Watershed

2. **Lead Agency Name and Address:**
   California Regional Water Quality Control Board
   3443 Routier Road, Suite A
   Sacramento, CA 95827-3098

3. **Contact Person and Phone Number:**
   Al Vargas, Associate Land and Water Use Analyst
   (916) 255-3089, CalNet 8-494-3089

4. **Project Location:**
   Grassland Watershed and the lower San Joaquin River from Sack Dam to Vernalis

5. **Project Sponsor's Name and Address:**
   California Regional Water Quality Control Board
   3443 Routier Road, Suite A
   Sacramento, CA 95827-3098

6. **General Plan Designation:**
   Not Applicable

7. **Zoning:**
   Not Applicable

8. **Description of Project:**

   The California Regional Water Quality Control Board, Central Valley Region, is proposing to amend the Water Quality Control Plan (Basin Plan) for the San Joaquin River Basin. The purpose of the proposed amendment is to formally list the beneficial uses of Grassland watershed water bodies currently impacted by agricultural subsurface drainage, adopt water quality objectives for selenium, and adopt an implementation strategy to bring agricultural subsurface drainage discharges into compliance with the water quality objectives.

9. **Surrounding Land Uses and Setting: (Briefly describe the project's surroundings):**

   The areas impacted by this basin plan amendment include the Grassland watershed and the lower San Joaquin River downstream of Sack Dam. The land uses in the Grassland watershed are urban, agriculture, and wetlands. The wetlands of the Grassland watershed are composed of duck clubs and state and federal wildlife refuges and management areas. These wetlands form important habitat for migratory waterfowl. Agriculture dominates land use upstream of the wetland areas.

10. **Other public agencies whose approval is required (e.g., permits, financing approval or participation agreement):**

    The State Water Resources Control Board
    Office of Administrative Law

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

- [x] Land Use and Planning
- [ ] Population and Housing
- [ ] Geological Problems
- [ ] Water
- [ ] Air Quality
- [ ] Transportation/Circulation
- [ ] Biological Resources
- [ ] Energy and Mineral Resources
- [ ] Hazards
- [ ] Noise
- [ ] Mandatory Findings of Significance
- [ ] Public Services
- [ ] Utilities and Service Systems
- [ ] Aesthetics
- [ ] Cultural Resources
- [ ] Recreation

Findings:

1. The proposed regulation (Basin Plan Amendment), subject of this review, does not prescribe changes in land use planning. However, drainers may chose to alter land use practices, such as land retirement and reuse of drainage, as a means to comply with the regulations. Reuse of drainage may result in degradation of soil quality and reduced agricultural productivity. An extended compliance schedule is provided for in the recommended alternative, which it is believed will allow sufficient time to develop management schemes to reduce the impacts of reuse of drainage and to develop treatment options which will reduce the need to reuse drainage as a means of complying with the regulations. It is, however, not possible to predict the extent of the impacts and of the mitigation since the technologies have not yet been fully developed and since it is the discretion of drainers to select the means by which they comply with the regulations.

2. Economic impacts may result to the drainers and the local communities as a result of compliance with the proposed regulations. These impacts could result from costs associated with treatment of drainage, loss of productivity as a result of land retirement, changes in cropping patterns to more salt tolerant crops, and degraded soil quality from drainage reuse. An extended, phased compliance schedule has been provided in the recommended alternative that will distribute the costs of compliance over an extended period of time and which will give communities the opportunity to adapt to approaching changes. This is the mitigation that has been provided for this impact. However, it is not possible to predict the extent that these impacts will occur since costs of treatment options are not available because technologies have not been fully developed.

Dennis Westcot
Signature

3/21/96
Date

Dennis W. Westcot, Environmental Program Manager
Printed Name

Cal. Regional Water Quality Control Board, Central Valley Region

EVALUATION OF ENVIRONMENTAL IMPACTS:

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impacts simply does not apply to projects like the one involved (e.g. the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g. the project will not expose sensitive receptors to pollutants, based an a project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts,

3) "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect is significant. ~~If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.~~

4) "Potentially Significant Unless Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less than Significant Impact" The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII "Earlier Analysis," maybe cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). Earlier analyses are discussed in Section XVII at the end of the checklist

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g. general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated. See the sample question below. A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

7) This is only a suggested form and lead agencies are free to use different ones.

| Issues (and Supporting Information Sources): | Potentially Significant Impact | Potentially Significant Unless Mitigation Incorporated | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| SAMPLE QUESTION:<br>Would the proposal result in potential impacts involving: | | | | |
| Landslides or mud slides?(1,6) | ☐ | ☐ | ☐ | ■ |
| (Attached source list explains that 1 is a general plan, and 6 is a USGS topo map. This would probably not need further explanation.) | | | | |
| I. LAND USE AND PLANNING. Would the proposal: | | | | |
| a) Conflict with general plan designation or zoning?(I 1) | ☐ | ☐ | ☐ | ■ |
| b) Conflict with applicable environmental plans or policies adopted by agencies with jurisdiction over the project?(I 1) | ☐ | ☐ | ☐ | ■ |
| c) Be incompatible with existing land use in vicinity? (I 1) | ☐ | ☐ | ☐ | ■ |
| d) Affect agricultural resources or operations (e.g., impacts to soils or farmlands or impacts from incompatible land uses)?(I 2) | ■ | ☐ | ☐ | ☐ |

| Issues (and Supporting Information Sources): | Potentially Significant Impact | Potentially Significant Unless Mitigation Incorporated | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| e) Disrupt or divide the physical arrangement of an established community (including a low-income or minority) community? (I 3) | ■ | ☐ | ☐ | ☐ |
| II. POPULATION AND HOUSING. Would the proposal: | | | | |
| a) Cumulatively exceed official regional or local population projections?(II) | ☐ | ☐ | ☐ | ■ |
| b) Induce substantial growth in an area either directly or indirectly (e.g., through projects in an undeveloped area or extension of major infrastructure)?(II) | ☐ | ☐ | ☐ | ■ |
| c) Displace existing housing, especially affordable housing?(II) | ☐ | ☐ | ☐ | ■ |
| III. GEOLOGIC PROBLEMS. Would the proposal result in or expose people to potential impacts involving: | | | | |
| a) Fault rupture?(III) | ☐ | ☐ | ☐ | ■ |
| b) Seismic ground shaking?(III) | ☐ | ☐ | ☐ | ■ |
| c) Seismic ground failure, including liquefaction?(III) | ☐ | ☐ | ☐ | ■ |
| d) Seiche, tsunami, or volcanic hazard?(III) | ☐ | ☐ | ☐ | ■ |
| e) Landslides or mud flows?(III) | ☐ | ☐ | ☐ | ■ |
| f) Erosion, changes in topography or unstable soil conditions from evacuation, grading, or fill?(III) | ☐ | ☐ | ☐ | ■ |
| g) Subsidence of the land?(III) | ☐ | ☐ | ☐ | ■ |
| h) Expansive soils?(III) | ☐ | ☐ | ☐ | ■ |
| I) Unique geologic or physical features?(III) | ☐ | ☐ | ☐ | ■ |
| IV. WATER. Would the proposal result in: | | | | |
| a) Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?(IV 1,2) | ☐ | ☐ | ■ | ☐ |

| Issues (and Supporting Information Sources): | Potentially Significant Impact | Potentially Significant Unless Mitigation Incorporated | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| b) Exposure of people or property to water related hazards such as flooding?(IV 1,3) | ☐ | ☐ | ☐ | ■ |
| c) Discharge into surface waters or other alteration of surface water quality (e.g. temperature, dissolved oxygen or turbidity)? (IV 1,4) | ☐ | ■ | ☐ | ☐ |
| d) Changes in the amount of surface water in any water body? (IV 1,2) | ☐ | ☐ | ■ | ☐ |
| e) Changes in currents, or the course or direction of water movements?(IV 1,2) | ☐ | ☐ | ☐ | ■ |
| f) Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations or through substantial loss of groundwater recharge capability?(IV 1,5) | ☐ | ☐ | ☐ | ■ |
| g) Altered direction or rate of flow of groundwater?(IV 1,5) | ☐ | ☐ | ☐ | ■ |
| h) Impacts to groundwater quality?(IV 1,5) | ☐ | ☐ | ☐ | ■ |
| I) Substantial reduction in the amount of groundwater otherwise available for public water supplies?(IV 1,6) | ☐ | ☐ | ☐ | ■ |
| V. AIR QUALITY. Would the proposal: | | | | |
| a) Violate any air quality standard or contribute to an existing or projected air quality violation?(V) | ☐ | ☐ | ☐ | ■ |
| b) Expose sensitive receptors to pollutants?(V) | ☐ | ☐ | ☐ | ■ |
| c) Alter air movement, moisture, or temperature, or cause any change in climate?(V) | ☐ | ☐ | ☐ | ■ |
| d) Create objectionable odors?(V) | ☐ | ☐ | ☐ | ■ |
| VI. TRANSPORTATION/CIRCULATION. Would the proposal result in: | | | | |
| a) Increased vehicle trips or traffic congestion?(VI) | ☐ | ☐ | ☐ | ■ |
| b) Hazards to safety from design features (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?(VI) | ☐ | ☐ | ☐ | ■ |

| Issues (and Supporting Information Sources): | Potentially Significant Impact | Potentially Significant Unless Mitigation Incorporated | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| c) Inadequate emergency access or access to nearby uses?(VI) | ☐ | ☐ | ☐ | ■ |
| d) Insufficient parking capacity on-site or off-site?(VI) | ☐ | ☐ | ☐ | ■ |
| e) Hazards or barriers for pedestrians or bicyclists?(VI) | ☐ | ☐ | ☐ | ■ |
| f) Conflicts with adopted policies supporting transportation (e.g. bus turn outs, bicycle racks)?(VI) | ☐ | ☐ | ☐ | ■ |
| g) Rail waterborne or air traffic impacts?(VI) | ☐ | ☐ | ☐ | ■ |
| VII. BIOLOGICAL RESOURCES. Would the Proposal result in impacts to: | | | | |
| a) Endangered, threatened or rare species or their habitats (including but not limited to plants, fish, insects, animals, and birds)?(IV 1, VII 1) | ☐ | ☐ | ☐ | ■ |
| b) Locally designated species (e.g. heritage trees)?(IV 1, VII 1) | ☐ | ☐ | ☐ | ■ |
| c) Locally designated natural communities (e.g. oak forests coastal habitat, etc.)?(IV 1, VII 1) | ☐ | ☐ | ☐ | ■ |
| d) Wetland habitat (e.g. marsh, riparian and vernal pool)?(IV 1, VII 1,2) | ☐ | ☐ | ☐ | ■ |
| e) Wildlife dispersal or mitigation corridors?(IV 1, VII 1) | ☐ | ☐ | ☐ | ■ |
| VIII. ENERGY AND MINERAL RESOURCES. Would the proposal: | | | | |
| a) Conflict with adopted energy conservation plans?(VIII) | ☐ | ☐ | ☐ | ■ |
| b) Use non-renewable resources in a wasteful and inefficient manner?(VIII) | ☐ | ☐ | ☐ | ■ |
| c) Result in the loss of availability of a known mineral resource that would be of future value to the region and the residents of the State?(VIII) | ☐ | ☐ | ☐ | ■ |
| IX. HAZARDS. Would the proposal involve: | | | | |
| a) A risk of accidental explosion or release of hazardous substances (including, but not limited to: oil, pesticides, chemicals or radiation)?(IX 1) | ☐ | ☐ | ☐ | ■ |

| Issues (and Supporting Information Sources): | Potentially Significant Impact | Potentially Significant Unless Mitigation Incorporated | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| b) Possible interference with an emergency response plan or emergency evacuation plan?(IX 2) | ❑ | ❑ | ❑ | ■ |
| c) The creation of any health hazard or potential health hazard?(IX 3) | ❑ | ■ | ❑ | ❑ |
| d) Exposure of people to existing sources of potential health hazards?(IX 3) | ❑ | ❑ | ❑ | ■ |
| e) Increased fire hazard in areas with flammable brush, grass, or trees?(IX 4) | ❑ | ❑ | ❑ | ■ |
| X. NOISE. Would the proposal result in: | | | | |
| a) Increases in existing noise levels?(X) | ❑ | ❑ | ❑ | ■ |
| b) Exposure of people to severe noise levels?(X) | ❑ | ❑ | ❑ | ■ |
| XI. PUBLIC SERVICES. Would the proposal have an effect upon, or result in a need for new or altered government services in any of the following areas: | | | | |
| a) Fire protection?(XI) | ❑ | ❑ | ❑ | ■ |
| b) Police protection?(XI) | ❑ | ❑ | ❑ | ■ |
| c) Schools?(XI) | ❑ | ❑ | ❑ | ■ |
| d) Maintenance of public facilities, including roads?(XI) | ❑ | ❑ | ❑ | ■ |
| e) Other governmental services?(XI) | ❑ | ❑ | ❑ | ■ |
| XII. UTILITIES AND SERVICE SYSTEMS. Would the proposal result in a need for new systems or supplies, or substantial alterations to the following utilities: | | | | |
| a) Power or natural gas?(XII 1) | ❑ | ❑ | ❑ | ■ |
| b) Communications systems?(XII 1) | ❑ | ❑ | ❑ | ■ |
| c) Local or regional water treatment or distribution facilities?(XII 2) | ❑ | ❑ | ■ | ❑ |
| d) Sewer or septic tanks?(XII 1) | ❑ | ❑ | ❑ | ■ |

| Issues (and Supporting Information Sources): | Potentially Significant Impact | Potentially Significant Unless Mitigation Incorporated | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| e) Storm water drainage?(XII 1) | ☐ | ☐ | ☐ | ■ |
| f) Solid waste disposal?(XII 1) | ☐ | ☐ | ☐ | ■ |
| g) Local or regional water supplies?(XII 1) | ☐ | ☐ | ☐ | ■ |
| **XIII. AESTHETICS. Would the proposal:** | | | | |
| a) Affect a scenic vista or scenic highway?(XIII) | ☐ | ☐ | ☐ | ■ |
| b) Have a demonstrable negative aesthetic effect?(XIII) | ☐ | ☐ | ☐ | ■ |
| c) Create light or glare?(XIII) | ☐ | ☐ | ☐ | ■ |
| **XIV. CULTURAL RESOURCES. Would the proposal:** | | | | |
| a) Disturb paleontological resources?(XIV) | ☐ | ☐ | ☐ | ■ |
| b) Disturb archaeological resources?(XIV) | ☐ | ☐ | ☐ | ■ |
| c) Affect historical resources?(XIV) | ☐ | ☐ | ☐ | ■ |
| d) Have the potential to cause a physical change which would affect unique ethnic cultural values?(XIV) | ☐ | ☐ | ☐ | ■ |
| e) Restrict existing religious or sacred uses within the potential impact area?(XIV) | ☐ | ☐ | ☐ | ■ |
| **XV. RECREATION. Would the proposal:** | | | | |
| a) Increases the demand for neighborhood or regional parks or other recreational facilities?(XV) | ☐ | ☐ | ☐ | ■ |
| b) Affect existing recreational opportunities?(XV) | ☐ | ☐ | ☐ | ■ |
| **XVI. MANDATORY FINDINGS OF SIGNIFICANCE.** | | | | |
| a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? | ☐ | ■ | ☐ | ☐ |

| Issues (and Supporting Information Sources): | Potentially Significant Impact | Potentially Significant Unless Mitigation Incorporated | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| b) Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? | ❑ | ❑ | ❑ | ■ |
| c) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects) | ❑ | ❑ | ❑ | ■ |
| d) Does the Project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? | ❑ | ❑ | ❑ | ■ |

## XVII. EARLIER ANALYSES.

Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, one or more effects have been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case a discussion should identify the following on attached sheets:

a) Earlier analyses used. Identify earlier analyses and state where they are available for review.

b) Impacts adequately addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in . an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures ~ based on the earlier analysis.

c) Mitigation measures. For effects that are "Less than Significant with Mitigation Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project. ENVIRONMENTAL CHECKLIST FORM

**THERE WERE NO EARLIER ANALYSES DONE ON THIS PROJECT.**

## Attachment I

## I. Land Use and Planning

1. The proposed project establishes water quality objectives for the lower San Joaquin River and its tributaries in the Grassland watershed (Mud Slough (north), Salt Slough, and the wetland supply channels) and a program of implementation to achieve these objectives. The Regional Board is statutorily tasked to take action in water quality control (Water Code §13225) and as such the proposed basin plan amendment does not conflict and is not incompatible with other regulations or land use designations. Furthermore, the proposed basin plan amendment does not address land uses and thus, does not interfere with general plans or land use designations.

2. While the project itself does not prescribe any alterations in land use practices, drainers may choose to alter land use practices as one of the means by which to comply with water quality objectives. These could include land retirement and recirculation (reuse) of subsurface drainage for irrigation rather than discharging it. Reuse of drainage may result, over time, in degradation of soils through accumulation of salts and toxic trace elements. The extent of land retirement and reuse of drainage necessary to achieve compliance with water quality objectives is unknown and thus, the amount of land that could be impacted by degraded soils is unknown. It is also unknown to what extent reuse of drainage could result in degradation of soil quality. Reuse of drainage has only been practiced in the Westlands Water District (to any major extent) and data on the impacts to soil quality are not available due to litigation (CVRWQCB, 1995c, Appendix I).

   The potential impacts of agricultural reuse may be mitigated by the extended compliance schedule of the recommended alternative (10 years for wet years and 15 years for dry years in the San Joaquin River downstream of the Merced River confluence and 15 years in the San Joaquin River between Sack Dam and the Merced River and Mud Slough (north)). During this period, cost-effective treatment technologies and management schemes (e.g. passive groundwater management, land retirement) may be developed that may reduced the need for agricultural drainage reuse.

3. The proposed basin plan amendment will not directly result in disruptions of communities. However, actions that drainers may take as a means to comply with water quality objectives proposed in the basin plan amendment could potentially result in reduced agricultural production and consequently displace employment associated directly or indirectly with agricultural production and cause economic hardship on local communities.

Reduced agricultural production may result from land retirement; also, from reuse of agricultural drainage which may potentially degrade soil quality and reduce crop yield or require the production of more salt tolerant but less profitable crops. Other means of compliance will also have costs associated with them (e.g. treatment of drainage). These means of compliance could potentially have economic impacts on the farming communities. The extended compliance schedule of the recommended alternative (10 years for wet years and 15 years for dry years in the San Joaquin River downstream of the Merced River confluence and 15 years in the San Joaquin River upstream of the Merced River and Mud Slough (north)) allows for mitigation of some of these impacts by providing for an extended period of time to allow for absorption of impacts. During this period, communities can develop alternate sources of employment and revenues. Additionally, the cost to drainers is also spread out over an extended period of time, thereby, mitigating economic impacts on drainers and on farming employment.

The extent to which economic disruption of these communities occurs as a result of land use changes depends on the extent to which land retirement occurs, soil productivity is degraded, and the ability of the affected communities to adapt to these changes. The extent that other means of compliance economically impacts farming communities depends on the magnitude of the costs of compliance and the ability of the drainers to absorb these costs. The extended compliance schedule of the recommended alternative is intended to mitigate these impacts. However, since treatment alternatives are still in the development stages, it is not possible to predict the extent of impacts and mitigation.

## II. Population and Housing

It is not anticipated that the proposed basin plan amendment, which addresses water quality of the lower San Joaquin River and in the Grassland watershed, will directly or indirectly impact population growth or housing in the region. The proposed plan does not have any impacts directly or indirectly on land use designation and planning.

## III. Geologic Problems

The proposed project, which establishes a regulatory program to control agricultural subsurface drainage in the Grassland watershed and the San Joaquin River, will have no impact on the geology of the region and thus, will not expose people to additional geologic hazards.

## IV. Water

1. The proposed basin plan amendment establishes policies, and regulatory actions to control agricultural subsurface drainage (drainage) discharges to surface waters of the Grassland watershed and the lower San Joaquin River. These discharges are impairing

the beneficial uses of these waters and degrading water quality. The proposed amendment identifies beneficial uses of water bodies presently affected by drainage and establishes water quality objectives for selenium that takes into consideration the beneficial uses of these water bodies. The proposed basin plan amendment also outlines an implementation plan which includes a combination of discharge prohibitions and phased implementation of water quality objectives with performance goal milestones for selenium concentrations.

The proposed basin plan amendment will, in itself, not result in direct negative environmental impacts. However, there may be potential impacts from actions taken by farmers who generate drainage (drainers) as a means to comply with provisions of the basin plan amendment. One such possible action envisioned is the use of a portion of the San Luis Drain to bypass drainage from the wetland channels in order to comply with the 2 $\mu$g/L selenium water quality objective for these channels and a discharge prohibition of drainage to these channels. A set of environmental documents (USBR, 1995a, and Panoche Drainage District, 1995a and b) have been finalized with respect to the use of a portion of the San Luis Drain as a wetland bypass. These documents satisfy both federal (National Environmental Policy Act (NEPA)) and California (California Environmental Quality Act (CEQA)) environmental impact analysis regulations and statutes.

The responses to the checklist considers both the direct (impacts caused directly as result of the basin plan amendment) and indirect impacts (impacts caused as a result of actions others may take to comply with the basin plan amendment). Wherever the response deals with the use of the wetland bypass, the environmental documents already prepared to address these impacts have been cited and pertinent sections paraphrased or quoted. It is anticipated that future projects, that may be initiated as a means to comply with the basin plan amendment, will address environmental impacts in State required environmental documents.

2. Agricultural subsurface drainage from the Grassland watershed is presently routed to the San Joaquin River through either Salt Slough or Mud Slough (north). Since 1993, agricultural subsurface drainage has been routed primarily through Salt Slough (Vargas et al., 1995). As a means to comply with the proposed basin plan amendment, drainers are likely to bypass subsurface drainage from the wetland channels including Salt Slough and discharge it to Mud Slough (north). The change in drainage management will result in increased flows in Mud Slough (north) with an equivalent decrease in Salt Slough.

   Maximum discharges from the wetland bypass to Mud Slough (north) are well within historic flows in Mud Slough (north) and no significant increase in flooding, or impacts due to flooding, within Mud Slough (north) are anticipated (USBR, 1995a).

Nevertheless, aerial surveillance will be conducted prior to and after implementation of the wetland bypass to determine impacts on discharge patterns, if any.

The diversion of drainage solely to Mud Slough (north) will partially restore the drainage patterns to those which existed prior to 1966. Prior to 1966, Mud Slough (north) drained the alluvial fan and the basin rim physiographic zones and consequently received all of the drainage from the Drainage Problem Area. Salt Slough drained only the flood plain. The construction of City Gates in 1966 disrupted the natural drainage patterns by permitting the diversion of basin rim and alluvial fan drainage into Salt Slough. This diversion resulted in a degradation of Salt Slough water quality due to introduction of poorer water quality from the Mud Slough (north) drainage area (CVRWQCB, 1996 draft, Appendix B). The discharge of agricultural subsurface drainage to Mud Slough (north) will restore the water quality of Salt Slough and permit the exercising of water rights (19,000 acre-feet) by the San Luis National Wildlife Refuge.

3. As a means to comply with the certain provisions of the basin plan amendment, drainers are likely to bypass the wetland channels by using a portion of the San Luis Drain and eventually discharge the drainage to Mud Slough (north). It is anticipated that drainage discharges to Mud Slough (north) will not result in significant increase in flooding or impacts due to flooding because the maximum discharges from the drain to Mud Slough (north) are well within historical flows in Mud Slough (north) (USBR, 1995a).

   At the suggestion of the California Department of Fish and Game, a new channel, (1500 feet long) will be constructed to prevent drainage water from entering two ponded areas in the China Island Wildlife Area. Back flow of drainage into tributary channels will be prevented by blocking these channels (Panoche Drainage District, 1995a).

   To prevent potential erosion at the discharge point of the bypass into Mud Slough (north), a discharge structure will be provided with energy dissipation and appropriate alignments. Bank stabilization will be provided for if necessary (Panoche Drainage District, 1995a).

4. Drainage has been discharged to Grassland watershed surface waters since 1950 when subsurface drainage systems where first installed in the Drainage Problem Area (CVRWQCB, 1996). Prior to 1966, all drainage generated from the Drainage Problem Area was discharged to Mud Slough (north). In 1966 a diversion structure (City Gates Bypass) was constructed that permitted the diversion of drainage to Salt Slough. Since 1966, management practices of drainage to Mud Slough (north) has varied. In some years drainage has been diverted only seasonally to Mud Slough

(north). In other years, drainage has been excluded completely from Mud Slough (north).

The year-round discharge of drainage to Mud Sough (north) will restore the drainage patterns to those which existed prior to 1966. The discharge of drainage will stabilize flow conditions in Mud Slough (north) which is subject to low flow conditions, especially during below normal water years (CVRWQCB, 1996 draft, Figure 10b). The anticipated discharges to Mud Slough (north) are well within the historic flows in Mud Slough (north) and no significant increase in flooding or impacts due to flooding are anticipated (USBR, 1995a). The discharges to Mud Slough (north) should be contained within the natural flow channels of Mud Slough (north) and will partially restore drainage to pre-1966 conditions.

The year-round diversion of drainage to Mud Slough (north) will result in improvements in 93 miles of surface waters (wetland supply channels and Salt Slough) in the Grassland watershed. The drainage discharged to Mud Slough (north), through the wetland bypass is, however, of poor quality and will further degrade the already poor water quality in Mud Slough (north) (CVRWQCB, 1996 draft, Figures 14 and 16b). Water quality and biological monitoring will be conducted in Mud Slough (north) to assess impacts, if any, resulting from increased drainage discharges. In the absence of drainage, Mud Slough (north) has been observed to have elevated salinity (as measured by electrical conductivity), boron, and molybdenum concentrations (Vargas et al., 1995, Figures 8 and 11).

The water quality planning conducted in association with the basin plan amendment identified the beneficial uses of Mud Slough (north), along with other Grassland watershed water bodies, based on past, present, and potential uses. Subsequently, water quality objectives were established for selenium that considered the protection of these uses. As a final step, an implementation program was developed to achieve compliance with the water quality objectives in Mud Slough (north). As a result of this basin plan amendment, water quality will improve in Mud Slough (north) over time to allow full realization of beneficial uses.

Compliance with water quality objectives will occur over the long-term and in increments. First, a selenium load discharge limitation of 8,000 pounds per year will be implemented, which will result in limiting selenium loads to Mud Slough (north) and all water bodies downstream. Further improvements in water quality will occur by October 2002 when performance goals in the San Joaquin River become effective and again in October 2005. Full compliance with water quality objectives in Mud Slough (north) will occur by October 2010.

The fate of the selenium transported through the wetland channels is unknown but some (as much as 20 percent) is believed to be chemically transformed and immobilized in channel sediments or transferred to the wetlands and sequestered there. Using the wetland bypass channel may result in a decrease in these potential selenium reductions. Thus, the potential exists for increased discharges of selenium to the San Joaquin River (USBR, 1995a). The basin plan amendment prohibits such an increase by setting an annual selenium load limit. The annual load limit is based on historic selenium loads leaving the Drainage Problem Area prior to movement through the wetland channels. In addition, annual load reduction targets that have been negotiated into an agreement for use of a portion of the San Luis Drain as a wetland bypass. These limits will be enforced by a fee assessment for violation of monthly and annual load targets (USBR, 1995a, Appendix 3).

5. A mass balance analysis was conducted for a segment of Mud Slough (north) from 1987 to 1989. This analysis was to assess the impacts on Mud Slough (north) from the agricultural drainage plume that has migrated into the groundwater below the former Kesterson Reservoir (USBR, 1995b). The mass balance calculations revealed a net groundwater inflow to Mud Slough (north). Thus, Mud Slough (north) does not appear to recharge the groundwater and thus, drainage conveyed through Mud Slough (north) should have no impact on groundwater flow direction, quality or quantity.

6. Groundwater in the vicinity of Mud Slough (north) has been identified to have domestic and municipal water supply beneficial uses (CVRWQCB, 1988). However, as noted in item 9, Mud Slough (north) does not recharge the groundwater and thus, should not have an impact on the beneficial uses of the groundwater.

## V. Air Quality

The proposed regulatory program which establishes water quality objectives and a plan of implementation to achieve these objectives, will have no direct or indirect impact on air quality.

## VI. Transportation Circulation

The proposed regulatory program addresses water quality issues in the lower San Joaquin River and Grassland area water bodies. This action will have no impact on traffic or transportation infrastructure of the region.

## VII. Biological Resources

1. The Regional Water Quality Control Board (Regional Board) has consulted with the Department of Fish Game (DFG) with respect to the California Endangered Species Act and as it relates to this proposed basin plan amendment. DFG has informed the Regional Board of a preliminary finding of no jeopardy. DFG is in the process of preparing a formal response.

Informal consultations have been initiated with the US Fish and Wildlife Service (USFWS) and the DFG by the US Bureau of Reclamation, in connection with the use of a portion of the former San Luis Drain and the connection of the drainage conveyance system and the San Luis Drain. The findings of these two agencies have been that the proposed project will not impact threatened and endangered species, as long as selenium concentrations do not increase as a result of use of the drain. Also, it was determined that the area where construction will take place is not suitable habitat for endangered species (giant garter snake specifically), however, certain mitigation measures were to be taken to protect any giant garter snakes present in the area (USBR, 1995a, Appendix 2). Also, mitigation measures will be undertaken during construction of the drainage conveyance extension to protect cultural resources (USBR, 1995a).

With respect to potential migration of migratory fish into Mud Slough (north) as a result of the attractive flows in the slough, it had been proposed that a barrier be installed on Mud Slough (north) at the confluence with the San Joaquin River. However, DFG is presently operating a fish barrier on the San Joaquin River upstream of the Merced River from October through December (the migratory period) to prevent migration of salmon further upstream into the San Joaquin River. Thus, a barrier is no longer needed at Mud Slough (north) (USBR, 1995a). The USBR will also consult with the USFWS with respect to maintenance and operations (grading, use of herbicides, etc.) that have potential to impact threatened and endangered species.

Finally, a comprehensive monitoring program will be implemented as part of the use agreement for a portion of the former San Luis drain as a wetland bypass. The monitoring program includes biological, sediment, and water quality. The results of the monitoring will be reviewed on a regular basis by an "Oversight Committee." If unacceptable impacts are identified by the Oversight Committee, mitigation measures will be identified and implemented.

2. The proposed regulatory program will result in protection of channels used in wetland water supplies and thus, will have no negative impact on wetland habitat or wildlife.

## VIII. Energy and Mineral Resources

The proposed regulatory program addresses water quality issues in the lower San Joaquin River and the Grassland area and will have no impact on energy and mineral resources.

## IX. Hazards

1. The proposed basin plan amendment, does not create an opportunity for accidental explosions or hazardous material releases as it lays out policies and regulatory actions to restore and protect water quality in the Grassland watershed and the lower San Joaquin River from elevated levels of selenium. Selenium concentrations in the waterbodies of concern do not now and are not expected to exceed the Hazardous Waste Threshold as define in Section 66900 and 66699, Title 22 of the California Code of Regulations. However, the possible use of a wetland bypass as a means to comply with water quality objectives in the wetland channels may create opportunities for release of selenium in concentrations which can impact the environment.

2. The proposed basin plan amendment and possible response from the drainers, in order to comply with the water quality objectives are not expected to interfere with local emergency plans.

3. The regulatory actions proposed will lead to the clean up of the wetland supply channels and Salt Slough by October 1, 1996, if not sooner. This action will eliminate potential health risks from exposures to elevated levels of selenium.

   Discharges of selenium laden drainage will, however, continue in Mud Slough (north). Since this will become a nearly year round event, fish tissue concentrations of selenium may increase. As part of the monitoring program that is part of the use agreement for the San Luis Drain, fish tissue concentrations will be monitored in all affected water bodies. If health thresholds are exceeded, a prohibition on fishing and gathering will be placed. The drainers will provide the financial or other assistance to the DFG for notification and enforcement (USBR, 1995a).

   The regulatory actions being considered will lead to the eventual correction of the water quality conditions in all of the water bodies presently impacted by agricultural subsurface drainage. Potential hazards from exposure to elevated selenium in Mud Slough (north) will be mitigated by health advisories and eventual correction of drainage caused water quality problems in the Grassland watershed and lower San Joaquin River.

4. The proposed regulatory actions and possible response from the drainers, in order to comply with the water quality objectives, are not expected to result in additional risk of fire.

## X. Noise

The proposed regulatory actions and possible response from the drainers, in order to comply with the water quality objectives, are not expected to result in increased noise levels or exposure to people to noise.

## XI. Public Services

The proposed regulatory actions and possible response from the drainers, in order to comply with the water quality objectives, will not result in increased need for public services for any of the items listed.

## XII. Utilities and Service Systems

1. The proposed regulatory actions and possible response from the drainers, in order to comply with the water quality objectives, will not result in increased use of existing utility and service systems except as noted in item XII, 2.

2. In order to comply with the regulatory requirements imposed on the drainers, the drainers may opt to treat the drainage to remove the selenium, when a technology is made available to accomplish this. If this occurs, the drainers will finance the construction of the treatment system and will not burden existing waste water treatment facilities.

## XIII. Aesthetics

The proposed regulatory actions and possible response from the drainers, in order to comply with the water quality objectives, will not result in impacts to the aesthetics of the region.

## XIV. Cultural Resources

The primary disturbances anticipated at this time from compliance with the proposed basin plan amendment is the construction of 1 mile of channel connecting the drainage conveyance system with the San Luis Drain. This area has been surveyed for biological resources (see item 13) and historic value. It has been concluded that this area has been extensively farmed and no historic properties identified. In the event that historic or archeological artifacts are located during excavation, construction will be halted and the find evaluated by an anthropologist familiar with the region (USBR, 1995a).

## XV. Recreation

The proposed regulatory actions and possible response from the drainers, in order to comply with the water quality objectives, will not impact the recreational infrastructure or recreational opportunities of the region.

## Statement of Overriding Consideration

The wetlands of the Grassland watershed form the largest continuous wetland habitat in the Central Valley and are considered by the U.S. Fish and Wildlife to be the most important in the Central Valley. The impacts of selenium on migratory waterfowl have been well documented through the Kesterson experience and other investigations of the U.S. Fish and Wildlife Service (USFWS). Selenium laden agricultural subsurface drainage has been discharged from the Grassland watershed to the San Joaquin River via Mud Slough (north) and Salt Slough since 1950. The concentrations of selenium presently being discharged to Grassland watershed wetland supply channels and through natural water bodies which traverse wetlands and wildlife refuges are well above threshold limits that would result in toxic effects to wildlife.

A regulatory program has been in effect since 1989. For reasons outlined in the staff report and because the current regulatory effort has not been effective in achieving its goals, a new regulatory program is proposed. The environmental impacts (both direct and indirect) have been analyzed by completion of the Environmental Checklist provided in Appendix I of the CEQA Guidelines and staff report completed in lieu of an Environmental Impact Report as per Section 21080.5 of CEQA.

The proposed regulation outlines policies and water quality objectives for the affected water bodies. The regulations do not prescribe a means by which drainers will comply with the regulations. Rather it is the discretion of the drainers to select the method by which they will comply. The environmental analysis has not identified any direct significant impacts of the proposed regulations on the environment. However, potential significant impacts have been identified by actions that are likely to be taken by drainers. It is not possible to determine if these impacts will be realized because technologies have not been fully developed and because the means of compliance will be selected by the drainers. As mitigation, an extended compliance schedule and phasing of water quality objectives has been provided in the alternative selected. It is not known the extent of the mitigation since the costs of compliance are only estimates.

Despite the potential significant impacts to soil resources and to the local communities, there is an overriding need to protect sensitive environmental resources threatened by selenium laden discharges and to protect the beneficial uses of the lower San Joaquin River. Additionally, the Regional Board must undertake these actions to comply with statutory mandates as expressed in the Porter-Cologne Water Quality Control Act. The proposed regulation is deemed to be a balance between protection of environment and minimizing economic hardships.

# REFERENCES


Ayers, R.S., and Westcot, D.W., 1985. *Water Quality for Agriculture*. FAO Irrigation and Drainage Paper 29. Food and Agriculture Organization of the United States.

Brown, L.R., unpublished. *National Water Quality Assessment Program*. U.S. Geological Survey. Sacramento, California

California Department of Fish and Game (CDFG), 1987. *The Status of San Joaquin Drainage Chinook Salmon Stocks, Habitat Conditions and Natural Production Factors*. Prepared for the State Water Resources Control Board Bay/Delta Hearing Process Phase I: Determination of Beneficial Uses and Determination of Reasonable Levels of Protection. DFG Exhibit #8.

California Department of Water Resources (DWR), 1988. *Water Temperature Effects on Chinook Salmon*. Northern District Office.

California State Water Resources Control Board (SWRCB), 1987. *Regulation of Agricultural Drainage to the San Joaquin River*. SWRCB Order No. W.Q. 85-1 Technical Committee Report. Final Report and Appendices.

Central Valley Regional Water Quality Control Board (CVRWQCB), 1988. *Beneficial Use Assessment* Per State Water Resources Control Board Order WQ 87-3.

Central Valley Regional Water Quality Control Board (CVRWQCB), 1994. *Grassland Basin Irrigation and Drainage Study, Volumes 1 and 2*. Prepared under contract by Cal Poly Irrigation Training and Research Center. California Regional Water Quality Control Board, Central Valley Region.

Central Valley Regional Water Quality Control Board (CVRWQCB), 1995a. *Staff Report on the Beneficial Uses Designations and Water Quality Critieria to be Used for the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin Basin (5C)*. California Regional Water Quality Control Board, Central Valley Region. June.

Central Valley Regional Water Quality Control Board (CVRWQCB), 1995b. *Staff Report on the Compliance Time Schedule to be Used for the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin River Basin*. California Regional Water Quality Control Board, Central Valley Region. November.

Central Valley Regional Water Quality Control Board (CVRWQCB), 1995c. *Staff Report on the Water Quality Objectives and Implementation Plan to be Used for the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin River Basin*. California Regional Water Quality Control Board, Central Valley Region. August.

Central Valley Regional Water Quality Control Board (CVRWQCB), 1995d. *Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins*. California Regional Water Quality Control Board, Central Valley Region.

Central Valley Regional Water Quality Control Board (CVRWQCB) 1995e. *Water Quality Control Plan for the Tulare Lake Basin.* California Regional Water Quality Control Board, Central Valley Region.

Central Valley Regional Water Quality Control Board (CVRWQCB), 1996 draft. *Beneficial Use Assessment of Grassland Area Waterbodies.* California Regional Water Quality Control Board, Central Valley Region.

Chilcott, J., Karkoski, J., and Ryan, M.R., 1995. *Agricultural Drainage Contribution to Water Quality in the Grassland Area of Western Merced County California: October 1992 to September 1993.* California Regional Water Quality Control Board, Central Valley Region.

Chilcott, J., Karkoski, J., Ryan, M.R., and Laguna, C., 1995. *Water Quality of the Lower San Joaquin River: Lander Avenue to Vernalis; October 1992 to September 1994; (Water Years 1993 and 1994).* California Regional Water Quality Control Board, Central Valley Region.

Environmental Defense Fund (EDF), 1994. *Plowing New Ground - Using Economic Incentives to Control Water Pollution from Agriculture.*

Grober, L.F. and Karkoski, J., 1995. *Modeling the Water Quality Impacts of Wetlands on San Joaquin River, California.* AWRA Symposium on Advances in Model Use and Development in Water Resources; Houston, Texas.

Jennings, E.M., 1994 (memorandum to Dennis Westcot - Region 5). *Application of the Tributary Footnote In the Water Quality Control Plan for the RWQCB, Central Valley Region, Basins 5a, 5b, and 5c.* Office of Chief Counsel, State Water Resources Control Board.

Karkoski, J., Young, T., Congdon, C. and Haith, D.A., 1993. *Development of a Selenium TMDL for the San Joaquin River.* Management of Irrigation and Drainage Systems. Irrig. and Drainage Systems Div./ASCE; July 21-23, 1993, Park City, Utah.

Karkoski, J., 1994. *A Total Maximum Monthly Load Model for the San Joaquin River.* California Regional Water Quality Control Board, Central Valley Region.

Lemly and Smith, 1987. *Aquatic Cycling of Selenium: Implications for Fish and Wildlife.* USFWS Leaflet 12.

Maier, K.J. and Knight, A., 1994. *Ecotoxicology of Selenium in Freshwater Systems, Reviews of Environmental Toxicology.* 134:31-48.

Moyle, P.B., 1976. *Inland Fishes of California.* University of California Press.

Panoche Drainage District. 1995a. *Addendum to Negative Declaration - Use of the San Luis Drain for Conveyance of Drainage Water and Bypass of Wetland Areas. July 11, 1995.* Filed in Merced County.

Panoche Drainage District. 1995b. *Addendum to Environmental Assessment/Initial Study for Proposed Use of the San Luis Drain for Conveyance of Drainage Water Through the Grassland Water District and Adjacent Grassland Areas.*

Pierson, F.W., E.W. James, and R. Thomasson, 1989a. *Hydrology Study of Mud Slough (north), Merced County.* California Regional Water Quality Control Board, Central Valley Region.

Pierson, F.W., E.W. James, and R. Thomasson, 1989b. *Hydrology Study of Salt Slough, Merced County.* California Regional Water Quality Control Board, Central Valley Region.

Presser, T.S., W.C. Swain, R.R. Tidball, and R.C. Severson, 1990. *Geologic Sources, Mobilization, and Transport of Selenium from the California Coast Ranges to the Western San Joaquin Valley: A Reconnaissance Study.* U.S. Geological Survey, Water Resources Investigations Report 90-4070.

Saiki, M.K., 1984. *Environmental Conditions and Fish Faunas in Low Elevation Rivers on the Irrigated San Joaquin Valley Floor, California.* U.S. Fish and Wildlife Service, Columbia National Fisheries Research Laboratory. California Fish and Game 70(3): 145-157.

Saiki, M.K., unpublished. National Biological Survey. National Fisheries Contaminant Research Center, Dixon, CA.

San Joaquin Valley Drainage Program (SJVDP), 1990a. *A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley.*

San Joaquin Valley Drainage Program (SJVDP), 1990b. *Fish and Wildlife Resources and Agricultural Drainage in the San Joaquin Valley, California.* Volume I

Skorupa, J.P. and Ohlendorf, H.M., 1991. *Contaminants in Drainage Water and Avian Risk Thresholds.* In the Economics and Management of Water and Drainage in Agriculture. Ariel Dinar and David Zilberman (eds.), Kluwer Academic Publishers.

Skorupa, J.P. personal communications, U.S. Fish and Wildlife Service, Sacramento, CA

U.S. Bureau of Reclamation (USBR), 1991a. *Offstream Storage Investigation Wetland Habitat Unit Final Report.* Prepared by U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement Field Office, Sacramento, California.

U.S. Bureau of Reclamation (USBR), 1991b. *Detailed Options Descriptions. San Luis Unit Drainage Program.*

U.S. Bureau of Reclamation (USBR), 1991c. *Plan Formulation Appendix. San Luis Unit Drainage Program.*

U.S. Bureau of Reclamation (USBR), 1995a. *Finding of No Significant Impact and Supplemental Environmental Assessment; Grassland Bypass Channel Project; Interim Use of a Portion of the San Luis Drain for Conveyance of Drainage Water through the Grassland Water District and Adjacent Grassland Areas.*

U.S. Bureau of Reclamation (USBR), 1995b. *1994 Annual Report for Revised Monitoring and Reporting Program No. 87-149.*

United States Department of Agriculture (USDA), 1952. *Soil Survey of the Los Banos Area California.* USDA Agricultural Research Administration Bureau of Plant Industry, Soils, and Agricultural Engineering. Series 1939, No. 12.

United States Environmental Protection Agency (USEPA), 1972. *Water Quality Criteria 1972.* A Report of the Committee on Water Quality Criteria.

United States Environmental Protection Agency (USEPA), 1987. *Water Quality Criteria for Selenium.* September 1987. EPA-440/5-87-006.

Vargas, A., Karkoski, J., and Ryan, M.R., 1995. *Agricultural Drainage Contribution to Water Quality in the Grassland Area of Western Merced County, California: October 1993 to September 1994.* California Regional Water Quality Control Board, Central Valley Region.

## APPENDIX 1

## GRASSLAND WATERSHED WETLAND WATER SUPPLY CHANNELS FOR WHICH BENEFICIAL USES HAVE BEEN IDENTIFIED

## Appendix 1 - Grassland Watershed Wetland Channels for Which Beneficial Uses Have Been Identified

### Southern Grassland Wetland Channels

| | Starting Location | Ending Location |
|---|---|---|
| Agatha Canal North | Starts at the Agatha North/Geis split at NE1/4, SE1/4, SE1/4, Sec. 12, T11S, R11E | Discharges to the Santa Fe Canal at Mueller Weir at NW1/4, SW1/4, SW1/4, Sec. 21, T10S, R11E |
| Agatha Canal South | Diversion from Helm or Main Canal at NW1/4, SE1/4, NE1/4, Sec. 31 T11S, R12E | Terminates at the Agatha North/Geis split at NE1/4, SE1/4, SE1/4, Sec. 12, T11S, R11E |
| Almaden Ditch | Begins at the Agatha Canal at Mallard Rd at SE1/4, NE1/4, SE1/4, Sec. 12, T11S, R11E | Terminates at Mesquite Drain siphon at the SW1/4, SW1/4, SW1/4, Sec. 11, T11E, R11E |
| Almond Drive Ditch | Diversions from the Main Canal and Main Drain at the SW1/4, SW1/4, SW1/4, Sec. 6, T11S, R10E | Discharges to Reedly Ditch at SW1/4, SW1/4, SW1/4, Sec. 5, T11S, R10E |
| Ascot Ditch | Diversion from the Main Canal at the SE1/4, SW1/4, SW1/4, Sec. 7, T11S, R11E | Terminates at the SW1/4, SE1/4, SE1/4, Sec. 8, T11S, R11E |
| Britto Ditch | Diversion from Camp 13 at the NW1/4, SE1/4, NE1/4, Sec. 22, T11S, R11E | Terminates at the SW1/4, SE1/4, NE1/4, Sec. 10, T11S, R11E |
| Camp 13 | Diversion of the Main Canal or Main Drain or Hamburg Drain at the SW1/4, SE1/4, SE1/4, Sec. 27, T11S, R11E, | Discharges to Mud Slough (south) at the SE1/4, NE1/4, NE1/4, Sec. 33, T10S, R11E |
| Charleston Drain | Freshwater diversions from the Outside Canal at the SW1/4, SW1/4, NE1/4, Sec. 32, T11S, R11E | Discharges to Upper Gadwall Ditch at the SW1/4, SW1/4, NW1/4, Sec. 6, T11S, R11E |
| Cocke Ditch | Diversion from the Arroyo Canal at the NE1/4, SW1/4, SW1/4, Sec. 21, T10S, R11E | Terminates at the NW1/4, SE1/4, SE1/4, Sec. 16, T10S, R11E |
| Colony Branch 2 | Enters the Southern Grassland at the SW1/4, NW1/4, SW1/4, Sec. 8, T11S, R12E | Drains into Bennett Drain at the NE1/4, SE1/4, NE1/4, Sec. 7, T11S, R12E |
| Colony Branch 3/Bennett | Enters the Southern Grassland at the SE1/4, SW1/4, SW1/4, Sec. 5, T11S, R12E | Terminates at the Agatha Canal North at the SW1/4, SW1/4, SW1/4, Sec. 6 T11S, R12E |
| Cotton Drain | Enters the Grassland at the NW1/4, NE1/4, SE1/4, Sec. 32, T10S, R11E | Discharges to Mud Slough (s) at the SE1/4, SW1/4, SE1/4, Sec. 28, T10S, R11E |
| Flyway Ditch | Diversion from Almond Dr. Ditch at SE1/4, SW1/4, SW1/4, Sec. 5, T11S, R11E | Discharges to Cotton Drain at the NW1/4, SE1/4, NE1/4, Sec. 32, T10S, R11E |

| | Starting Location | Ending Location |
|---|---|---|
| Gables Ditch | Diversion of Main Canal at the NE1/4, NW1/4, NW1/4, Sec. 31, T11S, R12E | Terminates at the SW1/4, NW1/4, SW1/4, Sec. 18, T11S, R12E |
| Geis Ditch | Begins at the Agatha North/Geis split at the NE1/4, SE1/4, SE1/4, Sec. 12, T11S, R11E | Discharges to Camp 13 at NW1/4, NW1/4, SW1/4, Sec. 3, T11S, R11E |
| Helm Canal | Takeouts from the Main Canal at NE1/4, SE1/4, NE1/4, Sec. 31, T11S, R11E | Terminates at the Helm Canal extension at the SW1/4, SW1/4, NW1/4, Sec. 26, T11S, R11E |
| Line Ditch | Enters Grassland at the SW1/4, SE1/4, NE1/4, Sec. 5, T11S, R12E | Terminates at the NE1/4, NE1/4, NE1/4, Sec. 6, T11S, R12E |
| Lower Gadwall Canal | Continuation of the upper Gadwall, starts at the Almond Dr. intersection at the SE1/4, SE1/4, SE1/4, Sec. 5, T11S, R11E | Discharges to Mud Slough (south) at the NE1/4, NE1/4, NW1/4, Sec. 33, T10S, R11E |
| Meyers Ditch | Diversion from Helm Canal at SE1/4, SW1/4, SW1/4, Sec. 26, T11S, R11E | Terminates at the SE1/4, SW1/4, SW1/4, Sec. 23, T11S, R11E |
| Mud Slough (south) | Begins at the end of Camp 13 at the SE1/4, NE1/4, NE1/4, Sec. 33, T10S, R11E | Discharges to Salt Slough at the Los Banos WA at the NW1/4, NE1/4, SW1/4, Sec. 18, T9S, R10E |
| Pozo Drain | Enters the GWD at SW1/4, SW1/4, SW1/4, Sec. 8, T11S, R12E | Discharges to the Agatha Canal North at the NE1/4, SE1/4, NE1/4 Sec. 12, T11S, R12E |
| Reedly Ditch | Continuation of Almond Dr. Drain at the SW1/4, SW1/4, SW1/4, Sec. 4, T11S, R11E | Discharges to Camp 13 at the SE1/4, SE1/4, SE1/4, Sec. 4, T11S, R11E |
| San Pedro Canal | Diversion from the Arroyo Canal at the NW1/4, NE1/4, NW1/4, Sec. 26, T10S, R11E | Discharges to Boundary/ Devon Drain at the NE1/4, NE1/4, SE1/4, Sec. 31, T9S, R11E |
| SLCC Arroyo Canal | Enters the Southern Grassland at the NE1/4, SE1/4, NE1/4, Sec. 25, T10S, R11E | Discharges to the Santa Fe Canal at Mueller Weir at the NW1/4, SW1/4, SW1/4, Sec. 21, T10S, R11E |
| Sorsky Ditch | Diversion of Camp 13 and continuation of Sorsky Bypass at the NE1/4, NW1/4, NW14, Sec. 27, T11S, R11E | Discharges to Camp 13 at SW1/4, SW1/4, SW1/4, Sec. 3 T11S, R11E |
| Stillbow Ditch | Begins at Bennett Ditch at the SW1/4, SE1/4, SW1/4, Sec. 6, T11S, R12E | Discharges to the Agatha Canal North at the SW1/4, NW1/4, NW1/4, Sec. 36, T10S, R11E |
| 240 Ditch | Diversion from Helm Canal at NE1/4, NW1/4, NW1/4, Sec. 36, T11S, R11E | Terminates at Sorsky Ditch at NE1/4, NW1/4, NE1/4, Sec. 23, T11S, R11E |
| Upper Gadwall Ditch | Diversion of Camp 13 at the NW1/4, SE1/4, SE1/4, Sec. 22, T11S, R11E | Terminates at Reedly Ditch at the NE1/4, NE1/4, NE1/4, Sec. 8, T11S, R11E |

## Northern Grassland Wetland Channels

| | Starting Location | Ending Location |
|---|---|---|
| Eagle Ditch | Diversion of the Santa Fe Canal at the NE 1/4, SE 1/4, NE 1/4, Sec. 30, T.8S, R.10E | Discharges to Mud Slough (north) at the SW 1/4, SE 1/4, NE 1/4, Sec. 7, T.8S, R.9E |
| Fremont Ditch | Diversion from San Luis Canal at the SE 1/4, SW 1/4, SW 1/4, Sec. 35, T.8S, R.10E | Discharges to Mud Slough (north) at the NW 1/4, NW 1/4, NE 1/4, Sec. 20, T.8S, R.10 |
| Garzas Creek | Enters Grassland Water District (GWD) at the intersection of Sections 22, 23, 26,27 T.8S, R.9E | Discharges to Los Banos Creek NE 1/4, NE 1/4, NE 1/4, Sec. 26, T.8S, R.9E |
| Gun Club Road Ditch | Diversion of Los Banos Cr at the intersections of Sections 13, 14, 23, 24, T.8S, R.9E | Terminates at Eagle Ditch at the SW 1/4, SE 1/4, SE 1/4, Sec. 13, T.8S, R.9E |
| Kesterson Ditch | Diversion of the Santa Fe Canal at the SE 1/4, SE 1/4, SW 1/4, Sec. 32, T.8S, R.10E | Terminates at the NW 1/4, NW 1/4, SE 1/4, Sec. 34, T.8S, R.10E |
| Los Banos Creek | Begins service at CCID Main Canal at the SE 1/4, SW 1/4, SW 1/4, Sec. 9, T.10S., R.10E | Discharges to Mud Slough (north) at the NE 1/4, NW 1/4, SW 1/4, Sec. 26, T.7S, R.9E |
| Mosquito Ditch | Diversion from the San Luis Wasteway at the NE 1/4, NW 1/4, NW 1/4, Sec. 19, T.9S, R.10E | Discharges to Los Banos Creek at NE 1/4, NE 1/4, SE 1/4, Sec. 6, T.9S, R10E |
| Rubino Ditch | Diversion of the San Luis Spillway at the SW 1/4, SE 1/4, SW 1/4, Sec. 17, T.9S, R.10E | Terminates at the NW 1/4, SW 1/4, SW 1/4, Sec. 8, T.9S, R.10E |
| San Luis Canal | Starts at a diversion of the Main Canal at NE 1/4, NW 1/4, SW 1/4, Sec. 36, T.10S, R.10E | NE 1/4, NE 1/4, SW 1/4, Sec. 5, T.8S, R.10E |
| San Luis Spillway Ditch | Diversion of the San Luis Wasteway at the intersections of Sections 17, 18, 19, 20, T.9S, R.10E | Discharges to the Santa Fe Canal at SE 1/4, SE 1/4, SW 1/4, Sec. 16, T.9S, R.10E |
| San Luis Wasteway[2] | | |
| Standard Ditch | Diversion from San Luis Canal at the NE 1/4, SE 1/4, NE 1/4, Sec. 25, T.9S, R.10E | Terminates at the NE 1/4, NE 1/4, SW 1/4, Sec. 15, T.9S, R.10E |
| Santa Fe Canal[1] | Extension of the Arroyo Canal at Mueller Weir at the NW 1/4, SW 1/4, SW 1/4, Sec. 21, T.10S, R.11E | Terminates at a tributary of Mud Slough (north) at the SW 1/4, SW 1/4, SE 1/4, Sec. 7, T.8S, R.10E |
| Santa Fe Canal Extension | Diversion of the Santa Fe Canal at the SW 1/4, Sec. 7, T.8S, R.10E | |
| Westside Ditch | Diversion of Garzas Cr at the intersection of Sections 22, 23, 26, 27, T.8S, R.9E | Discharges to Los Banos Creek at the SE 1/4, NW 1/4, NW 1/4, Sec. 11, T.8S, R..9E |

[1] Begins as an extension of the Arroyo Canal. Receives only SLCC operational spill water at this point.
[2] Source is the Delta-Mendota Canal.

## APPENDIX 2

## DETAILED EVALUATION OF IMPLEMENTATION ALTERNATIVES

## APPENDIX 2

## DETAILED EVALUATION OF IMPLEMENTATION ALTERNATIVES

Alternative 1 - Prohibition of Discharge

The Regional Board has the authority to prohibit discharge of agricultural subsurface drainage from the Drainage Problem Area (Water Code Section 13243) to all surface waters. Alternative 1 considers such a prohibition with an implementation date no later than October 1, 1996. Implementation of the prohibition would result in compliance with all proposed selenium water quality objectives.

Staff estimates that 47,500 acres in the Drainage Problem Area are tile drained and that an additional 10% of the land (4,750 acres) is "effectively" drained (Appendix 3). The impact of the prohibition would be greatest on those 52,250 acres that are actually or "effectively" drained.

A prohibition of discharge which is implemented in a short time frame (by October 1, 1996) would require the removal or plugging of tile drainage systems. The Bureau of Reclamation required the cessation of discharge from the 42,000 tile drained acres in Westlands Water District which discharged to Kesterson Reservoir until 1986. This action was in response to State Water Board Resolution No. 85-1 and was completed within 12 months by plugging discharge lines.

Since there is currently litigation regarding compensation for the action by the Bureau of Reclamation, there is no publicly available information on the on-farm impacts of the cessation of tile drainage. Cursory observations and anecdotal information indicate that crop yields have been reduced on some lands, some lands may go out of production, and other lands have suffered little or no impact since the tile lines were plugged.

Adoption of a prohibition would have a greater impact in the Drainage Problem Area than it did in the Westlands Water District and be more difficult to implement due to the difference in land use between the two areas. Westlands Water District encompasses greater than 400,000 acres of land. Even if all 42,000 tiled acres were to go out of production, the water district would still be a viable entity. There would still be a sufficient resource base to maintain the district's water delivery system.

In contrast, large scale land retirement of tile drained systems in the Drainage Problem Area could affect the viability of the whole water district. The tile drained areas cover a significant portion of the Drainage Problem Area water districts (>50%). The water districts would have great difficulty in maintaining their infrastructure if they were to lose such a large portion of their resource base.

In 1988, the State Water Board adopted a Nonpoint Source Management Plan (Resolution No. 88-123). The plan described three tiers for addressing nonpoint source pollution problems: 1) a voluntary approach; 2) the regulatory encouragement of BMP implementation; and 3) the adoption of effluent limits. The least stringent option which results in successful compliance with water quality objectives is to be chosen. The current implementation program uses a Tier 2 approach - the regulatory encouragement of BMP implementation. All five alternatives use a prohibition of discharge to meet water quality objectives in the wetland supply channels, Mud Slough (north), Salt Slough, and the San Joaquin River upstream of the Merced River. Staff analysis indicates that compliance with selenium water quality objectives is unlikely in the aforementioned water bodies if agricultural subsurface drainage water is present. Alternative 1 also uses a prohibition of discharge to meet water quality objectives in the San Joaquin River downstream of the Merced River. Alternative 1 does not use the least stringent regulatory option, since staff analysis indicates that reducing selenium loads by establishing effluent limits may result in compliance with water quality objectives in the San Joaquin River downstream of the Merced River confluence. Since effluent limits have not been tried, the prohibition is inconsistent with the State Water Board's Nonpoint Source Management Plan.

The State Water Board Pollution Policy Document (Resolution No. 90-67) requires the Central Valley Regional Board to develop a strategy for reducing selenium loading to the Delta. This strategy must be reflected in updates to the Basin Plan. The prohibition of discharge would remove all major sources of selenium load to the San Joaquin River; it is, therefore, consistent with Resolution No. 90-67.

In January 1992, the State Water Board chairman signed a Memorandum of Understanding (MOU) with various state and federal agencies. The MOU is an agreement by the agencies to use the management plan described in the September 1990 final report of the San Joaquin Valley Drainage Program (Final Report) as a guide for remedying subsurface drainage and related problems. The Final Report recommends drainage discharge to the San Joaquin River for the Grasslands area, combined with several other alternatives which should lead to load reductions and compliance with water quality objectives. Prohibition of discharge is inconsistent with the recommendations of the Final Report.

The Regional Board must also consider the effect of its actions as it relates to state and Federal anti-degradation policies. These policies do not allow for degradation of water quality in surface waters, except in certain exceptional circumstances. A prohibition of discharge would not cause degradation of any of the effected water ways and is, therefore, consistent with state and Federal anti-degradation policies.

Economic costs associated with a prohibition are unclear. One commenter (Felix E. Smith, 1995) suggested large scale land retirement as one method of accomplishing the prohibition. It was suggested that the cost of purchasing the land would be $1,000/acre or $90,000,000 for the Drainage Problem Area. The commenter also suggested that there would be less pesticides applied, less energy cost associated with pumping water from the Delta, and greater water available for fisheries in the Delta.

Another commenter (San Luis & Delta-Mendota Water Authority, 1995) has indicated that the total value of the economic activity in the Drainage Problem Area is $239 million/year. Large scale land retirement would substantially reduce, if not eliminate the economic activity in the area. A prohibition of discharge does not necessarily require land retirement, but over time crop yields in some areas would decrease and production would likely cease on other lands.

In summary, although an immediate prohibition of discharge is consistent with the State Water Board's Pollution Policy Document since selenium loads to the San Joaquin River are essentially eliminated, it is not consistent with the Nonpoint Source Management Plan, since a less stringent option of setting effluent limits has not been employed. A prohibition is also inconsistent with the recommendations of the San Joaquin Valley Drainage Program. Depending on how the prohibition is implemented, it could also result in the largest economic cost when compared to other alternatives.

Alternative 2 - Phased Implementation of Water Quality Objectives using Effluent Limits and a 20-25 year maximum compliance schedule.

The second alternative considered is to phase in compliance with water quality objectives over 20 to 25 years. This alternative is similar to that discussed in a public workshop held on September 22, 1995.

Waste discharge requirements would be used to regulate selenium loading and an extended compliance time schedule would be employed. Selenium data collected by Regional Board staff and other agencies has shown that water quality in the San Joaquin River below the Merced River confluence improves in response to load reductions. In contrast, water quality in the San Joaquin River above the Merced River confluence; the wetland water supply channels; Salt Slough and Mud Slough (north) only improves in the absence of agricultural subsurface drainage due to limited dilution flows. These facts were the primary considerations in developing the program of implementation.

Priority is given to the removal of subsurface drainage from wetland water supply channels and Salt Slough by October 1, 1996. A prohibition would be used to accomplish compliance. This action can be accomplished by consolidating the drainage water into as few channels as possible and routing the drainage to the final 9 miles of Mud Slough (north), using a separate conveyance channel for the drainage water. Rather than receiving subsurface drainage on a periodic or seasonal basis, this 9 mile reach of Mud Slough (north) will receive drainage water year-round. The discharge will have a negative impact on aquatic life in Mud Slough (north). To insure that this phase of implementation does not lead to degradation of the San Joaquin River, a maximum annual selenium load cap would be established that is based on historical loads entering the River.

The second phase of implementation focuses on the San Joaquin River below the Merced River confluence. Water quality at this point in the San Joaquin River improves in response to selenium load reductions. Therefore, waste discharge requirements will be used to establish monthly effluent limits on discharges from the Drainage Problem Area.

In the San Joaquin River downstream of the Merced River confluence, compliance with the adopted water quality objective for selenium would occur by October 1, 2010 for wet water year types. Compliance with the adopted water quality objective would occur by October 1, 2015 for dry water year types. Performance goals which reflect the previous Regional Board adopted water quality objectives would apply on October 1, 2005. Load limits will be incorporated into waste discharge requirements in order to achieve both performance goals and final water quality objectives. These load limits would represent a 25% reduction in load in wet years and a 55% reduction in dry years from the historical average to meet performance goals. The load limits required to meet final water quality objectives represent a 47% reduction in load in wet years and a 80% reduction in dry years from the historical average.

It is unlikely that reductions in the range of 47%-80% can be accomplished solely through improvements in irrigation practices. Staff analysis of possible load reduction strategies (Appendix 3) included two actions that are still in the development stage (passive water table management with trees and drainage water treatment). An extended time period for development would allow for setbacks in development and optimization of parameters prior to wide scale implementation of new technologies. An extended time period would also allow a more gradual implementation program. With gradual implementation, many technologies could be evaluated and the most cost effective technologies would be selected for wide scale implementation.

Staff estimates that if passive water table management were used, the development stage would be approximately 5-10 years, allowing for significant setbacks (such as a frost or pest damage). It would likely take 3-5 years before the trees were mature enough to achieve their maximum evapotranspiration rate. Gradual implementation (500-1,000 acres/year) would make this technology fully effective in reducing loads by the year 2010. This should be sufficient to meet the wet year annual load limits. In order to meet the load limits for dry years, further load reductions would be required.

One means of accomplishing further load reductions in dry years would be the implementation of a treatment process. There are several processes which are being evaluated at the pilot scale and it will likely take several years before the optimum process is selected and ready for implementation at the plant scale. Treatment processes generally involve both high capital and operating costs. An additional five years is allowed before compliance is required in dry year types to allow for setbacks in development and a sufficient time period to raise the necessary funds to build and construct the treatment plant and supporting infrastructure.

During the period of time when compliance is focused on load reductions (until October 1, 2020), agricultural subsurface drainage discharges will continue to be routed to Mud Slough (north). Annual selenium loads in Mud Slough (north) will decrease during this phase of implementation, as load reduction technology is implemented.

The third phase of implementation requires compliance with water quality objectives in the San Joaquin River upstream of the Merced River confluence and in Mud Slough (north). As with the first phase, this phase will likely require removal of agricultural subsurface drainage from those channels. The cost of constructing a separate conveyance system downstream of the Merced River confluence is high; $16-$28 million. Additional time is allowed for compliance, since significant resources will be required to comply with San Joaquin River objectives below the Merced River confluence. The compliance date would be October 1, 2020. A prohibition would be used to accomplish compliance, if treatment technologies prove unsuccessful.

As with alternative one, this alternative was evaluated for consistency with relevant State Water Board and Regional Board policies and interagency agreements with Porter-Cologne as follows:

The Regional Board adopted a watershed policy in 1994. Alternative 2 would include a policy statement and control action which articulates the best method for implementing the water quality objectives on a watershed basis. The new objectives apply to several different water bodies. Priority is given to those water bodies with the most sensitive uses and where the greatest environmental benefit is expected.

The compliance schedule is established such that the most sensitive use, wetlands in the Grassland area, is given priority. Compliance with the selenium water quality objective for Salt Slough and constructed wetland water supply channels will result in improvements in water quality in 31 miles of natural channel, 75 miles of wetland supply channels, and over 60,000 acres of wetlands. The next priority is compliance with selenium objectives in the San Joaquin River downstream of the Merced River. This will result in improvements in water quality in 44 miles of natural channel. The third priority is compliance with selenium objectives in Mud Slough (north). This will result in improvements in water quality in 11 miles of natural channel.

Expansion of the watershed policy as it applies to subsurface agricultural drainage is necessary in order to develop priorities for meeting objectives.

As discussed in alternative 1, the State Water Board's Nonpoint Source Management Plan suggests the adoption of effluent limits, if regulatory encouragement of BMP adoption does not result in compliance. Alternative 2 proposes the adoption of the Tier 3 approach (effluent limits) to manage agricultural subsurface drainage discharges to the San Joaquin River below the Merced River. A series of load reduction limits would be incorporated into waste discharge requirements to achieve water quality objectives. Adoption of effluent limits would be consistent with established State Water Board policy.

As discussed in alternative 1, the State Water Board Pollution Policy Document (Resolution No. 90-67) requires the Central Valley Regional Board to develop a strategy for reducing selenium loading to the Delta. Alternative 2 requires an initial cap on selenium loads and also requires selenium load reduction milestones to be incorporated into waste discharge requirements. The effluent limits in the waste discharge requirements must be consistent with Federal requirements for the implementation of a Total Maximum Daily Load (TMDL). Alternative two is consistent with State Water Board Resolution No. 90-67.

In January 1992, the State Water Board chairman signed a Memorandum of Understanding (MOU) with various state and federal agencies. The MOU is an agreement by the agencies to use the management plan described in the September 1990 final report of the San Joaquin Valley Drainage Program (Final Report) as a guide for remedying subsurface drainage and related problems. Many of the actions suggested in the Final Report were used as guidance in the development of alternative 2 - such as land retirement, agroforestry, and improved irrigation practices. Load reductions are recommended in the Final Report to meet water quality objectives in the San Joaquin River downstream of the Merced River and a separate conveyance facility is suggested to transport the subsurface drainage to that point. Consideration of the Final Report alternatives in the implementation of the new water quality objectives would be consistent with the MOU.

The Regional Board must consider the effect of Alternative 2 as it relates to state and Federal anti-degradation policies. Currently, Mud Slough (north) receives subsurface drainage periodically. Under Alternative 2, Mud Slough (north) would receive drainage continuously until October 1, 2020. Although 9 miles of Mud Slough (north) would be degraded, 31 miles of natural channels (including Salt Slough), 75 miles of wetland supply channels, and over 60,000 acres of wetlands would benefit from the removal of agricultural subsurface drainage, which contains high levels of selenium. Additionally, selenium loads to Mud Slough (north) and the San Joaquin River would be reduced over time. During the period of time in which Mud Slough (north) is receiving agricultural subsurface drainage, there would be a net improvement in water quality on a watershed basis . After October 1, 2020, the water quality in Mud Slough (north) would improve with the removal of agricultural subsurface drainage. In the long-term, implementation of Alternative 2 results in improvements in water quality in Mud Slough (north), Salt Slough, the wetland water supply channels, and the San Joaquin River over current conditions. The combination of long-term improvements in Mud Slough (north) and near term watershed improvements are consistent with state and Federal anti-degradation policies.

The time schedule for meeting selenium objectives in the San Joaquin River (15 years for wet years and 20 years for dry years) and Mud Slough (north) (25 years) should provide the necessary time to implement load reduction alternatives at the least economic cost. A time schedule for compliance similar to alternative 2 was supported by representatives of the Drainage Problem Area (San Luis & Delta-Mendota Water Authority, Appendix II), but was opposed by many other interested parties (e.g. U.S. Fish & Wildlife Service; Environmental Defense Fund; Contra Costa County; The Bay Institute - see Appendix 6). Successful compliance will require development and implementation of technologies that are not currently available.

In summary, alternative 2 is consistent with the State Water Board's Pollution Policy Document since selenium loads to the San Joaquin River are reduced to insure water quality objectives are met. Alternative 2 is consistent with the Nonpoint Source Management Plan, since the next most stringent regulatory approach, effluent limits, would be employed. Alternative 2 is consistent with the recommendations of the San Joaquin Valley Drainage Program, since the Final Report was used to guide the development of the alternative. Alternative 2 implements the Regional

Board's watershed policy. Depending on how alternative 2 is implemented, it should result in the least economic cost, while still meeting water quality objectives.

Alternative 3 - Phased Implementation of Water Quality Objectives using Effluent Limits and a 10-15 years maximum compliance schedule.

The third alternative considered also phases in compliance with water quality objectives over time. Based on a large number of comments received August, 1995 staff report that indicated the compliance schedule for alternative 2 was too long, a more aggressive time schedule for compliance is considered. The time schedule for compliance described below assumes the aggressive (and successful) development of new technologies.

Waste discharge requirements would be used to regulate selenium loading to the San Joaquin River below the Merced River and a shorter compliance time schedule than alternative 2 would be used. As with alternative 2, priority is given to the removal of subsurface drainage from wetland water supply channels and Salt Slough by October 1, 1996. A prohibition would be used to accomplish compliance. This action can be accomplished by consolidating the drainage water into as few channels as possible and routing the drainage to the final 9 miles of Mud Slough (north), using a separate conveyance channel for the drainage water. Rather than receiving subsurface drainage on a periodic or seasonal basis, this 9 mile reach of Mud Slough (north) will receive drainage water year-round. The discharge may have a negative impact on aquatic life in Mud Slough (north). To insure that this phase of implementation does not lead to degradation of the San Joaquin River, a maximum annual selenium load cap would be established that is based on historical loads entering the River.

The second phase of implementation focuses on the San Joaquin River below the Merced River confluence. Water quality at this point in the San Joaquin River improves in response to selenium load reductions. Therefore, waste discharge requirements will be used to establish monthly effluent limits on discharges from the Drainage Problem Area. The same monthly effluent limits would apply as in alternative 2, only compliance would be required in a shorter time period.

In the San Joaquin River downstream of the Merced River confluence, compliance with the adopted water quality objective for selenium would occur no later than October 1, 2005 for wet water year types. Compliance with the adopted water quality objective would occur no later than October 1, 2010 for dry water year types. Performance goals which reflect the previous Regional Board adopted water quality objectives would apply on October 1, 2002. The compliance dates for the performance goals and adopted water quality objectives are given in Table 4.

Load limits will be incorporated into waste discharge requirements to achieve performance goals and final water quality objectives. These load limits would represent a 25% reduction in load in wet years and a 55% reduction in dry years from the historical average to meet performance goals. The load limits required to meet final water quality objectives would represent a 47% reduction in load in wet years and a 80% reduction in dry years from the historical average.

As discussed in alternative 2, it is unlikely that improved irrigation practices alone will lead to the load reductions required. Aggressive development and implementation of new technologies will be required to achieve the necessary load reductions in the time frame outlined. Staff estimates that if passive water table management were used, the development stage would be approximately 5 years, with no significant setbacks. Since it would likely take 3-5 years before the trees were mature enough to achieve their maximum evapotranspiration rate, wide-scale implementation (3,000 acres) of this technology would not be fully effective in reducing loads until the year 2005. Therefore, compliance with selenium water quality objectives in wet years is not required until that time. In order to meet the load limits for dry years, further load reductions would be required.

One means of accomplishing further load reductions in dry years would be the implementation of a drainage water treatment process. There are several processes which are being evaluated at the pilot scale and it will likely take several years before the optimum process is selected and ready for implementation at the plant scale. Treatment processes generally involve both high capital and operating costs. The cost of implementing a treatment process and the third phase of the implementation program (see below) requires an extended compliance schedule. Therefore, an additional five years is allowed before compliance is required in dry year types.

During the period of time when compliance is focused on load reductions (until October 1, 2010), agricultural subsurface drainage discharges will continue to be routed to Mud Slough (north). Annual selenium loads in Mud Slough (north) will decrease during this phase of implementation, as load reduction technology is implemented.

The third phase of implementation requires compliance with water quality objectives in the San Joaquin River upstream of the Merced River confluence and in Mud Slough (north). As with the first phase, this phase will likely require removal of agricultural subsurface drainage from those channels. Due to the high cost of constructing a separate conveyance system downstream of the Merced River confluence ($16-$28 million), compliance is not required until the second phase of implementation is completed; October 1, 2010. A prohibition would be used to accomplish compliance, if treatment technologies prove unsuccessful.

This alternative was evaluated for consistency with relevant State Water Board and Regional Board policies and interagency agreements. It was also evaluated for consistency with Porter-Cologne. As it applies to the Regional Board watershed policy, the State Water Board's Nonpoint Source Management Plan, Pollution Policy Document, San Joaquin Valley Drainage Program MOU, and state and Federal anti-degradation policies, alternative 3 is equivalent to alternative 2.

The time schedule for meeting selenium objectives in the San Joaquin River (10 years for wet years and 15 years for dry years) and Mud Slough (north) (15 years) should provide the necessary time to implement load reduction alternatives. Alternative 3 should ensure that water quality improvements occur continuously with a lower cost than alternative one and a higher cost than alternative 2. Successful compliance will require aggressive development and implementation of technologies that are not currently available.

In summary, alternative 3 is consistent with the State Water Board's Pollution Policy Document since selenium loads to the San Joaquin River are reduced to insure water quality objectives are met. Alternative 3 is consistent with the Nonpoint Source Management Plan, since the least stringent regulatory options that are likely to result in compliance are being employed. Alternative 3 is consistent with the recommendations of the San Joaquin Valley Drainage Program, since the Final Report was used to guide the development of the alternative. Alternative 3 implements the Regional Board's watershed policy. Depending on how alternative 3 is implemented, it should result in less cost than a prohibition, while still meeting water quality objectives.

Alternative 4 - Phased Implementation of Water Quality Objectives using Effluent Limits and a 5-7 years maximum compliance schedule.

The fourth alternative considered also phases in compliance with water quality objectives over time. A compliance time schedule that reflects the recommendation of many commenters (Bay Institute; Contra Costa Water District; Felix E. Smith; USF&WS, San Luis Wildlife Refuge) is considered. The time schedule for compliance described below assumes the immediate implementation of new technologies that have not yet completed the development stage.

Waste discharge requirements would be used to regulate selenium loading to the San Joaquin River below the Merced River and a shorter compliance time schedule than alternative 3 would be used. As with alternative 3, priority is given to the removal of subsurface drainage from wetland water supply channels and Salt Slough by October 1, 1996. Alternatives 4 is equivalent to alternative three with respect to the regulatory mechanisms used to achieve compliance in the wetland water supply channels and Salt Slough.

The second phase of implementation focuses on the San Joaquin River below the Merced River confluence. Water quality at this point in the San Joaquin River improves in response to selenium load reductions. Therefore, waste discharge requirements will be used to establish monthly effluent limits on discharges from the Drainage Problem Area. The same effluent limits would apply as in alternative 3, only compliance would be required in a shorter time period. This alternative will require a much more aggressive program of load reductions than that suggested by the consensus letter signed by the U.S. Fish & Wildlife Service, U.S. Bureau of Reclamation, U.S. Environmental Protection Agency, and San Luis & Delta-Mendota Water Authority (Consensus Letter, 1995).

In the San Joaquin River downstream of the Merced River confluence, compliance with the adopted water quality objective for selenium would occur by October 1, 2000 for wet water year types. Compliance with the adopted water quality objective would occur by October 1, 2002 for dry water year types. Performance goals which reflect the previous Regional Board adopted water quality objectives would apply on October 1, 1998.

Load limits will be incorporated into waste discharge requirements to achieve both performance goals and final water quality objectives. These load limits would represent a 25% reduction in load in wet years and a 55% reduction in dry years from the historical average to meet performance goals. The load limits required to meet final water quality objectives would represent a 47% reduction in load in wet years and a 80% reduction in dry years from the historical average.

An aggressive implementation program will be required to achieve the necessary load reductions in the time frame outlined. Staff estimates that if passive water table management were used, the benefits from immediate, successful and wide-scale implementation (3,000 acres) of this technology would not be fully effective in reducing loads until the year 2000. Therefore, compliance with selenium water quality objectives in wet years is not required until that time. In order to meet the load limits for dry years, further load reductions would be required.

One means of accomplishing further load reductions in dry years would be the implementation of a drainage water treatment process. There are several processes which are being evaluated at the pilot scale. Design and construction of a treatment plant and supporting infrastructure would have to begin immediately. It would likely take several years before the drainage water treatment plant would be on-line.

During the period of time when compliance is focused on load reductions (until October 1, 2002), agricultural subsurface drainage discharges will continue to be routed to Mud Slough (north). Annual selenium loads in Mud Slough (north) will decrease during this phase of implementation, as load reduction technology is implemented.

The third phase of implementation requires compliance with water quality objectives in the San Joaquin River upstream of the Merced River confluence and in Mud Slough (north). As with the first phase, this phase will likely require removal of agricultural subsurface drainage from those channels. As discussed previously, the cost of this phase of implementation is very high ($16-$28 million).

This alternative was evaluated for consistency with relevant State Water Board and Regional Board policies and interagency agreements. It was also evaluated for consistency with Porter-Cologne. As it applies to the Regional Board watershed policy, the State Water Board's Nonpoint Source Management Plan, Pollution Policy Document, San Joaquin Valley Drainage Program MOU, and state and Federal anti-degradation policies alternative 4 is equivalent to alternative 2.

The time schedule for meeting selenium objectives in the San Joaquin River (5 years for wet years and 7 years for dry years) and Mud Slough (north) (7 years) is achievable only if technologies currently in the development are immediately implemented. Since development has not been completed, there is a great risk that large resources would be expended with little success.

In summary, alternative 4 is consistent with the State Water Board's Pollution Policy Document since selenium loads to the San Joaquin River are reduced to insure water quality objectives are met. Alternative 4 is consistent with the Nonpoint Source Management Plan, since the least stringent regulatory options that are likely to result in compliance are being employed. Alternative 3 is consistent with the recommendations of the San Joaquin Valley Drainage Program, since the Final Report was used to guide the development of the alternative. Alternative 4 implements the Regional Board's watershed policy. In the short term, Alternative 4 represents the highest cost of alternatives 2-5 with the least likelihood for success.

Alternative 5 - Regulatory Based Encouragement of BMPs

The current regulatory policy of the Regional Board for agricultural subsurface drainage focuses on regulatory encouragement of BMP implementation. Water quality objectives were adopted along with a compliance time schedule. Water conservation measures and other methods that are focused on source control were thought to be the most cost effective method for meeting water quality objectives.

A similar approach could again be adopted by the Regional Board. The previous Regional Board implementation program would have to be modified to reflect new State Water Board and Regional Board policies. A new time schedule for compliance would be developed along with a load reduction program. For purposes of evaluating this alternative, it will be assumed that alternatives 3 and 5 are equivalent, except alternative 3 will use effluent limits in the waste discharge requirements and alternative 5 will not.

Priority would be given to compliance in areas with the most sensitive uses and where the greatest environmental benefit is expected. A shorter compliance time schedule than alternative 2 would be used. Although selenium data collected by Regional Board staff and other agencies has shown that water quality in the San Joaquin River below the Merced River improves in response to load reductions, no effluent limits would be imposed.

Since the wetland ecosystem is most sensitive to selenium, priority is given to the removal of subsurface drainage from wetland supply channels by October 1, 1996. A prohibition would be used to accomplish compliance. This action can be accomplished by consolidating the drainage water into as few channels as possible and routing the drainage to the final 9 miles of Mud Slough (north), using a separate conveyance channel for the drainage water. Rather than receiving subsurface drainage on a periodic or seasonal basis, this 9 mile reach of Mud Slough (north) will receive drainage water year-round. The discharge may have a negative impact on aquatic life in Mud Slough (north). A prohibition on the maximum annual selenium load to the San Joaquin River would be established that is based on historic loads entering the river.

The second phase of implementation focuses on the San Joaquin River below the Merced River. The compliance date for water quality objectives in wet water year types would be October 1, 2005. The compliance date with water quality objectives in dry water year types would be October 1, 2010. Interim milestones which reflect the previous Regional Board adopted water quality objectives would apply on October 1, 2002. Waste discharge requirements would be considered if water quality objectives were not met, but are not required.

As with alternative 3, an aggressive development and implementation program would be necessary to achieve water quality objectives in the time frame outlined. Staff estimates that if passive water table management were used, the development stage would be approximately 5 years. Since it would likely take 3-5 years before the trees were mature enough to achieve their maximum evapotranspiration rate, wide-scale implementation (3,000 acres) of this technology would not be fully effective until the year 2005. In order to meet the dry year compliance date, other technologies would be required.

One means of accomplishing compliance with water quality objectives in dry years would be the implementation of a treatment process. There are several processes which are being evaluated at the pilot scale and it will likely take several years before the optimum process is selected and ready for implementation at the plant scale. Treatment processes generally involve both high capital and operating costs. The cost of implementing a treatment process and the third phase of the implementation program (see below) requires an extended compliance schedule. Therefore, an additional five years is allowed before compliance is required in dry year types.

During this period of time (until October 1, 2010), agricultural subsurface drainage discharges will continue to be routed to Mud Slough (north). There would be no regulation of selenium load levels in Mud Slough (north) during this phase of implementation.

The third phase of implementation requires compliance with water quality objectives in the San Joaquin River upstream of the Merced River and in Mud Slough (north). As with the first phase, this phase will likely require removal of agricultural subsurface drainage from those channels. Due to the high cost of constructing a separate conveyance system downstream of the Merced River ($16-$28 million), compliance is not required until the second phase of implementation is completed - October 1, 2010. A prohibition would be used to accomplish compliance.

This alternative was evaluated for consistency with relevant State Water Board and Regional Board policies and interagency agreements. It was also evaluated for consistency with Porter-Cologne.

The Regional Board adopted a watershed policy in 1994. Alternative 5 would include a policy statement and control action which articulate the best method for implementing the water quality objectives on a watershed basis. The new objectives apply to several different water bodies. Priority is given to those water bodies with the most sensitive uses and where the greatest environmental benefit is expected.

In 1988, the State Water Board adopted a Nonpoint Source Management Plan (Resolution No. 88-123). The plan described three tiers for addressing nonpoint source pollution problems: 1) a voluntary approach; 2) the regulatory encouragement of BMP implementation; and 3) the adoption of effluent limits. The least stringent option which results in successful compliance with water quality objectives is to be chosen. The current implementation program uses a Tier 2 approach - the regulatory encouragement of BMP implementation. This approach did not result in compliance with less stringent selenium water quality objectives. Alternative 5 uses a similar approach, so it is unlikely to result in compliance with more stringent selenium water quality objectives. Alternative 5 is inconsistent with established State Water Board policy since successful compliance with water quality objectives is unlikely.

The State Water Board Pollution Policy Document (Resolution No. 90-67) requires the Central Valley Regional Board to develop a strategy for reducing selenium loading to the Delta. This strategy must be reflected in updates to the Basin Plan. Alternative 5 would not require effluent limits, so it is not clear whether selenium loads would be reduced.

In January 1992, the State Water Board chairman signed a Memorandum of Understanding (MOU) with various state and federal agencies. The MOU is an agreement by the agencies to use the management plan described in the September 1990 final report of the San Joaquin Valley Drainage Program (Final Report) as a guide for remedying subsurface drainage and related problems. Alternative 3 and alternative five are equivalent with respect to the Final Report.

The time schedule for meeting selenium objectives in the San Joaquin River (10 years for wet years and 15 years for dry years) and Mud Slough (north) (15 years) should provide the necessary time to comply with water quality objectives. If water quality objectives are not met, additional time would be required to establish effluent limits in waste discharge requirements and a time schedule to meet those limits. Alternative 5 would be as costly as alternative 3 if water quality objectives were met. If water quality objectives were not met, the longer time period of compliance would result in a lower cost.

In summary, alternative 5 is not consistent with the State Water Board's Pollution Policy Document since no limit is placed on selenium loads to the San Joaquin River. Alternative 5 is not consistent with the Nonpoint Source Management Plan, since a program which failed to achieve water quality objectives would be employed for more stringent water quality objectives. Alternative 5 is consistent with the recommendations of the San Joaquin Valley Drainage Program, since the Final Report was used to guide the development of the alternative. Alternative 5 implements the Regional Board's watershed policy. Depending on how alternative 5 is implemented, it should result in less cost than a prohibition; however, water quality objectives, are unlikely to be met.

# APPENDIX 3

# ESTIMATED DRAINAGE REDUCTIONS FOR VARIOUS STRATEGIES

# APPENDIX 3

## ESTIMATED DRAINAGE REDUCTION FOR VARIOUS ACTIONS

### SUMMARY

This appendix attempts to determine if the selenium load reductions required to meet a 5 μg/L 4-day average selenium objective in the San Joaquin River in a dry year are technically achievable. The amount of drainage volume and load reduction that would occur with the implementation of various actions is also evaluated. The actions presented are not meant to be inclusive of all possible actions. The combination of actions presented are meant to illustrate one possible implementation strategy to meet a 5 μg/L 4-day average selenium water quality objective in the San Joaquin River solely through load reductions. The analysis presented is meant to provide a screening level assessment of the types of actions that may be needed and the degree of implementation that may be required to meet selenium effluent limits. Many of these actions must be implemented and monitored before their actual effectiveness can be determined.

### ASSUMPTIONS

1). Total irrigable acres in the drainage problem area[1] = 81,446.

The total irrigable acres represents the amount of land that is actually in production. Some portion of the land in the drainage problem area is dedicated to the infrastructure, such as roads, canals, ditches and buildings. The area occupied by these facilities is not included in the calculation of irrigable acres.

Stu Styles of California Polytechnic State University, San Luis Obispo provided information on total irrigable acres for Broadview WD (9,300), Firebaugh CWD (21,761), Panoche DD (37,714). Pacheco WD's Water Conservation Plan to the U.S. Bureau of Reclamation lists 4,391 irrigable acres. San Luis WD's Water Conservation Plan estimated acreage in Charleston Drainage District (4,300 acres). Irrigable acreage in Camp 13 (4,000 acres) is estimated from Appendix D of the 1994, California Polytechnic State University, San Luis Obispo page D-13.

2). Total tile drained acres in the drainage problem area = 47,500

(Data assembled by RWQCB based on information submitted by districts in the drainage problem area.) The total tile drained acres is used to estimate the effectively drained acres (see 5 below).

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[1] The drainage problem area includes Broadview Water District, the Camp 13 area of Central California Irrigation District, Charleston Drainage District, Firebaugh Canal Water District, Pacheco Water District, and Panoche Drainage District.

3). Average leakage through the Corcoran Clay = 0.3 acre-ft/acre

The leakage through the Corcoran Clay provides an estimate of the amount of deep percolation that does not have to be managed with respect to surface water impacts (i.e. the deep percolation will not appear in the tile drainage systems).

The SJVDP estimated that the leakage through the Corcoran Clay from the semi-confined aquifer to the confined aquifer was 0.3 acre-ft/acre. This estimate was applied to all areas evaluated. Estimates provided by Fio in California Polytechnic State University, San Luis Obispo 1994 Report (pg. 2-59) range from .26 acre-ft/acre (Firebaugh) to 0.51 acre-ft/acre (Panoche). In order to be consistent with the estimates used by the San Joaquin Valley Drainage Program, 0.3 acre-ft/acre is used as an estimate of leakage through the Corcoran Clay.

4). % of tile drainage contributed by upslope lands = 10%

Fio (U.S.G.S. Open File Report 94-45) estimated that upslope recharge contribution to tile drainage systems in the Panoche Drainage District was 11% of the total recharge to those systems. Since the upslope recharge was often also tile drained in Fio's model, a slightly lower estimate is used for undrained lands contributing to tile drainage.

5). Total "effectively" drained area in the drainage problem area (area tile drained + upslope lands contributing to tile drainage) = 52,800 acres

By combining the area actually drained with the upslope area that contributes to drainage production in the tiled area, an "effectively" drained area is defined. Since the upslope contribution is 10% of the total tile drainage, the area "effectively" tile drained in drainage problem area = 52,800 acres (Actual Tile Drained Acres/divided by 0.9)

In addition to estimating the contribution of upslope areas, Fio estimated the travel time for recharge from these upslope areas to reach the drained area. The travel time was between 10 and 90 years. Since the effect of any efforts to reduce deep percolation further upslope (in areas that do not contribute to tile drained areas) would likely be minimal, the "effectively" undrained area is not considered in the evaluation of actions.

The total irrigable acres is used in Table 3-4 to calculate the total effectively drained acres in production (irrigated drained acres). The ratio of the land in production to total irrigable acres is multiplied by the total effectively drained acres - this gives the total effectively drained acres in production in a given year. The total effectively drained acres in production is the denominator in columns 6 & 7 in Table 3-4.

6). Selenium concentration of imported surface water supplies and deep ground water supplies which become surface runoff (hereafter referred to as surface drainage) = 2 μg/L

The total drainage in the agricultural drainage channels is composed of drainage that originated from poor quality shallow groundwater (tile drainage) and surface drainage[2]. In order to distinguish between the quantity of poor quality tile drainage and the quantity of higher quality surface drainage, an estimate of the selenium concentration in the higher quality waters is needed. This estimate is used primarily in Table 3-4 in the calculation of the tile drainage produced (this calculation is discussed below).

The major source of irrigation supplies for the districts in the drainage problem area is the Delta-Mendota Canal. These supplies are supplemented at times with high quality ground water supplies and poor quality tile drainage water. Central California Irrigation District's Main Canal is representative of the quality of the imported surface supplies, which constitutes the overwhelming majority of the surface water supplies. The median selenium concentration of water in CCID's Main Canal is 1.7 μg/L based on Regional Board records from 1985-1994 (CVRWQCB, 1995). The 75th percentile concentration is 2.2 μg/L.

Work performed by the U.S.G.S. (Water Resources Investigations Report 88-4186) found that "most selenium in presently irrigated soils is in a forms that are resistant to leaching." Based on this finding, a significant transfer of selenium from the soil surface to the surface drainage is unlikely to occur. Therefore, the estimate of 2 μg/L selenium in the surface drainage is not adjusted to account for transfer of selenium from the soil surface.

7). Measured median selenium concentration in tile drainage for the drainage problem area = 134 μg/L
Calculated selenium concentration in tile drainage for the drainage problem area based on SJVDP assumptions = 119 μg/L

Based on published (CVRWQCB, 1988) and unpublished Regional Board data (1992) the mean selenium value of all Regional Board sump data for the drainage problem area was found to be 211 μg/L. The median value was found to be 134 μg/L. Flow data is not available for many of the sumps from which the Regional Board collected samples, so a flow weighted concentration value is not available. Additionally, samples were collected infrequently, so estimates of temporal changes in the average tile sump selenium concentration from the drainage problem area are not possible using the Regional Board's data. Therefore, the median selenium concentration was initially used to represent the tile drainage concentration. Further analysis (see discussion of historical deep percolation below) indicated that the tile drainage concentration should be further adjusted to 119 μg/L to be consistent with assumptions from the SJVDP and observed selenium loads.

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[2] A distinction is made between surface drainage which is defined in this report as originating from imported surface water supplies and high quality ground water supplies as opposed to tail water which may include recycled tile drainage water.

The use of a single selenium concentration in tile drainage for the screening analysis performed in this report is supported by Fio and Leighton's work in the Panoche Drainage District (U.S.G.S. Open File Report 94-72). Fio and Leighton found a linear relationship between tile drain flow and load - the slope of this line would provide an average selenium concentration for tile drainage systems in the District. Fio and Leighton also stated that this relationship would likely change over the long term if irrigation recharge (excess deep percolation) decreased or if increased pumping took place.

Earlier work performed by the U.S.G.S. (Water Resources Investigations Report 88-4186) also found that "The lack of clear and general seasonal patterns in drain-water salinity or selenium concentrations, despite distinct seasonal patterns in irrigation and drain flow, underscores the fact that drains collect ground water, which tends to be of relatively constant character over time at a particular location". This finding also supports the use of a single tile drainage selenium concentration value for the purposes of this report. Both the use of the measured median selenium value and a calculated value are evaluated below (see historical deep percolation discussion). To provide consistency with the assumptions of the SJVDP, the calculated value of 119 µg/L selenium in tile drainage is used to assess historical trends and the potential effects of improved irrigation practices and passive water table management.

Historical Deep Percolation

In order to assess the likely effectiveness of various actions, a base deep percolation should be established for the above assumptions.

The SJVDP estimated that 1.05 acre-ft/acre of deep percolation was produced in the Grasslands area around 1987. Since 0.30 acre-ft/acre leaks through the Corcoran Clay, 0.75 acre-ft/acre would be expected in the tile drainage systems. A review of historical data indicates that 81.5% of the irrigable acres were in production in 1987 (which is the time period used to estimate the amount of deep percolation). If the percentage of land fallowed is the same in effectively drained land and undrained land in the drainage problem area, approximately 43,000 acres of land were effectively drained in 1987.

(1) Effectively drained area in production = (Total effectively drained area)(% of land fallowed)
= (52,800 acres) (0.815) = 43,000 acres

If it is assumed that the total drainage leaving the drainage problem area contains a poor quality, shallow groundwater component (tile drainage) and a higher quality surface and deep groundwater component (surface drainage), continuity equations on selenium load and flow can be written:

(2) $$Q_{Total}*C_{Total} = Q_{Tile}*C_{Tile} + Q_{Surface}*C_{Surface}$$

$Q_{Total}$: represents the flow rate for the total amount of drainage .
$Q_{Surface}$: represents the flow rate of the component of the tail water which originated as surface and high quality groundwater supplies.
$Q_{Tile}$: represents the flow rate of the tile drainage.

$C_{Total}$: represent the selenium concentration of the total drainage.
$C_{Surface}$: represents the selenium concentration of the component of the tail water which originated as surface and high quality groundwater supplies.
$C_{Tile}$: represents the selenium concentration of the tile drainage.

(3) $$Q_{Total} = Q_{Tile} + Q_{Surface}$$

If 0.75 acre-ft/acre was being produced in the tile drainage systems in 1987, the volume of tile drainage would have been 32,000 acre-ft. The total drainage (tile + surface) actually produced was 73,700 acre-ft (CVRWQCB, 1995). Using the initial estimated selenium concentration of 134 µg/L and rearranging equations 2 and 3, the calculated selenium load would have been.

(4) $$Q_{Total}{*}C_{Total} = Q_{Tile}{*}C_{Tile} + (Q_{Total} - Q_{Tile}){*}C_{Surface} = [(134\ \mu g/L{*}32{,}000 \text{ acre-ft}) + (2\ \mu g/L{*}(73{,}700\text{-}32{,}000)\text{acre-ft})] \times 0.00272 \text{ lbs}/[\mu g/L / \text{acre-ft}] = 11{,}900 \text{ lbs Se}$$

The actual selenium load produced was 10,700 lb. in 1987 (CVRWQCB, 1995).

The likely sources of error between the calculated and observed values are: the estimated deep percolation produced in the tile drainage systems (0.75 acre-ft/acre), the effectively drained area (43,000 acres in 1987), the estimated selenium concentration in the tile drainage systems (134 µg/L), and errors in calculating the actual total drainage and selenium load produced.

Rather than adjusting all of these parameters, the estimated selenium concentration from the tile drainage systems will be altered to be consistent with observed selenium loads and the key assumptions used by the SJVDP. Additional justification includes: 1) the sump data collected by the Regional Board was not flow-weighted when statistics were performed - due to lack of flow information; 2) the annual selenium concentration in the total drainage (surface + tile) from the drainage problem area appears to be leveling off at a much lower value than would be expected based on the median tile sump concentration (the average concentration of total drainage outflow is currently around 80 µg/L); and 3) the investigations of the U.S.G.S. provide some justification for using a single tile drainage concentration value.

The purpose of establishing a tile drainage concentration value is to provide a basis for analyzing the potential selenium load reductions that would occur if various load reduction actions were implemented. The use of a single value to represent selenium tile drainage concentration is based on a lack of data, rather than a reflection of actual conditions. Justification could also be provided for adjusting the deep percolation value, but in order to be consistent with the analysis of the San Joaquin Valley Drainage Program, this value is not adjusted (also see discussion under sensitivity analysis).

By changing the estimated average tile drainage selenium concentration to 119 µg/L and assuming a concentration of 2 µg/L in surface drainage, the calculated selenium load produced in 1987 is 10,700 lb.

Given the assumptions of historical deep percolation production of 0.75 acre-ft/acre in tile drained areas and an average selenium concentration of 119 μg/L in the tile drainage, the amount of load reduction that one would expect from implementing various actions which reduce deep percolation can be evaluated. If the actual selenium concentration of tile drainage is higher, a greater degree of load reduction will occur for a given action; conversely, if the actual selenium concentration of tile drainage is lower, a lesser degree of load reduction will occur for a given action which reduces deep percolation. In addition to the evaluation of actions with the assumptions described above, a sensitivity analysis is performed by varying the surface and tile drainage selenium concentrations. Sensitivity analysis is also performed on the effectiveness of improved irrigation practices and passive water table management for various concentrations of selenium in tile drainage.

## ACTIONS EVALUATED

### IMPROVED IRRIGATION PRACTICES

The SJVDP (1990) estimated that implementation of improved irrigation practices would result in a reduction in deep percolation of approximately 0.35 acre-ft/acre. This would leave approximately 0.40 acre-ft/acre that would have to be managed. For purposes of this analysis, it is assumed that the implementation of improved irrigation practices results in no surface runoff. Drip systems and sprinklers produce little or no surface runoff and well managed furrow systems would include tail water return systems. Therefore, the selenium load contribution of surface drainage is assumed to be zero when irrigation practices are improved.

### PASSIVE WATER TABLE MANAGEMENT

Trees or deep rooted crops could be used to draw on the ground water system to satisfy evapotranspiration needs. Eucalyptus have potentially high ET rates (5 acre-ft/acre/year - SJVDP), but this rate drops as salinity increases. If eucalyptus were planted in areas of high, though not excessive ground water salinity, high ET could be maintained. Current difficulties related to agroforestry include potential wildlife hazards when drainage water is brought to the surface and the salinization of the soil profile (Letey and Knapp; J. Env. Qual. 24:934-940 (1995)). The problem of soil salinization could be overcome if the agroforestry plots were tile drained and a disposal option for the brine was available.

Some of the problems associated with reuse on trees could be overcome if the trees tapped directly into the ground water. Little or no management to prevent potential wildlife impacts would then be necessary.

Agronomic crops could also be used to lower the water table through ground water use. Use of agronomic crops may be more cost effective than the use of trees, which have a questionable value as a commodity. For the purposes of this analysis, it will be assumed that eucalyptus would be used with an evapotranspiration rate of 4 acre-ft/acre. This analysis will consider implementation of this action on 3,000 acres of land (the SJVDP suggested 3,100 acres for drainage water reuse on trees and halophytes in the year 2000 and 2,600 acres in the year 2040).

## TREATMENT

In recent testimony in Federal Court, consultants to Westlands Water District indicated that an affordable treatment process (using anaerobic bacteria) was available to reduce selenium concentrations in drainage water from 300 µg/L to 50 µg/L. The cost of this process was estimated to be $300/acre-ft. According to the consultants' testimony, this process can be scaled up from its current pilot demonstration to full scale operation.

In the drainage problem area, effective employment of this treatment process would involve processing only those sumps with high selenium levels. This would minimize the size of the facility and the cost of transporting the sump water to the plant. This analysis will assume the same initial and final selenium concentrations as presented in the Westland's testimony. Using tile drainage high in selenium in the evaluation of the treatment action means that the average tile drainage concentration of the remaining drainage would decrease. This decrease is not considered in this screening level analysis.

## LAND RETIREMENT/LAND FALLOWING

The recommendation of the SJVDP to retire 3,000 acres of land will be used to estimate the amount of load reduction that would occur. For purposes of this assessment, tiled lands draining into the top five selenium load producing sumps for the Drainage Service Area will be retired. The five sumps produce about 1,400 pounds of selenium and 1,800 acre-ft of tile drainage annually (average concentration 285 µg/L). The tile drainage removed by land retirement has a higher selenium concentration than the assumed average tile drainage concentration for the drainage problem area. Removing drainage high in selenium in the evaluation of the land retirement action means that the average tile drainage concentration of the remaining drainage would decrease. This decrease is not considered in this screening level analysis.

For purposes of this evaluation, the distribution of land fallowing is assumed to be equal among effectively drained and undrained lands.

## RESULTS OF IMPLEMENTATION OF THE ABOVE ACTIONS

Three scenarios were evaluated using the assumptions described above. Scenarios 1 and 2 evaluated reductions from the same base case: 1987 conditions - approximately 0.75 acre-ft/acre of deep percolation coming from the "effectively" tile drained land and 18.5% of that land fallowed. Scenario three considered land fallowing of 5%, but the same level of deep percolation (acre-ft/acre) as in 1987. Based on the assumptions regarding improved irrigation practices, passive water table management and land retirement, surface drainage and the load associated with surface drainage is eliminated under all scenarios.

The first scenario (1) was based on a combination of improved irrigation on 38,100 acres, passive water table management on 3,000 acres (conversion to eucalyptus), and 3,000 acres of land retirement. The amount of land fallowed was the same for the base conditions under scenario 1 and conditions in 1987 (18.5% of land fallowed). Irrigation improvement was not applied to lands which were retired or on which trees were planted.

The results of this scenario are shown in Table 3-1. The total selenium load is reduced from 10,700 pounds annually to 890 pounds with the implementation of these three actions.

The 890 pounds of selenium discharged after implementation of the three actions is 110 pounds lower than the annual average discharge allowed for a dry year type if the selenium objective is a 5 µg/L 4-day average. Scenarios 2 and 3 are constructed to reach the same 890 pound selenium load level. This is done not to suggest a new, more stringent limit, but to provide a basis for comparison of the different scenarios.

The second scenario (2) was based on a combination of improved irrigation, passive water table management, and treatment. The amount of land fallowed was the same for the base conditions under scenario 2 and conditions in 1987. Irrigation improvement was not applied to lands on which trees were planted.

The results of scenario 2 are shown in Table 3-2. The acres of trees planted is consistent with scenario 1. The number of acres of land in which improved irrigation is applied increases to 40,600 acres, since there is not a land retirement component. Treatment is used to account for the remaining load reduction necessary to meet the 890 pound level.

Since improved irrigation practices are applied to more land, it accounts for more load reduction than occurred in scenario 1. Passive water table management accounts for the same amount of load reduction as in scenario 1, and 1,620 acre-ft of tile drainage (300 µg/L Se) must be treated.

Scenario 3 is equivalent to scenario 2, except that only 5 % of the land is fallowed (Table 3-3). Since less land is fallowed the base case load in scenario 3 is higher than the base case load in scenarios 1 and 2 (12,400 lbs vs. 10,700 lbs). Irrigation improvements are again applied to all land in production, so the amount of load reduced by improved irrigation is higher than in scenarios 1 or 2. The amount of treatment needed must be increased to 2,930 acre-feet to meet the 890 pound level.

As mentioned previously, the 890 pound load level would be below the annual discharge allowed for a dry year type. The amount of load that could be discharged in a wet year would be more than three times greater (3,087 lb.). The implications of the higher wet year load for the scenarios evaluated are that treatment may not be necessary, less land would need to be fallowed, or retired land could be brought back into production.

## Historical Perspective

The assumptions regarding selenium concentration of tile drainage and effective tile drained acreage were applied to historical data to assess the changes, if any, in deep percolation. Total tile volume was calculated based on the assumed selenium concentration in tile drainage, a 2 µg/L concentration of selenium in surface drainage, and the actual combined drainage concentration and flow. Combining equations (2) and (3) and rearranging:

(5) $Q_{Tile} = Q_{Total} \, (C_{Total} - C_{Surface}) \, / \, (C_{Tile} - C_{Surface})$

The data (Table 3-4) indicates that the amount of tile drainage in acre-ft/irrigated drained acre decreased steadily from a high in 1987 (which was set at 0.75) to a low in 1992 of 0.37. In 1993, this number increased to 0.56 acre-ft/irrigated drained acre and then decreased to 0.50 in 1994.

The 0.37 acre-ft/acre produced in 1992 is approximately the amount of deep percolation that the SJVDP felt would be left to manage once irrigation improvements were implemented. It is likely that this number was a result of a combination of improved irrigation management and increased recirculation brought on by the drought. The higher numbers in 1993 and 1994 may have been the result of increased water application for leaching.

It should also be noted that the relative percentage of tile water in the total drainage increased throughout the period of record. This is consistent with the implementation of irrigation management systems which are more effective at capturing surface runoff.

## SENSITIVITY ANALYSIS

A sensitivity analysis was performed on scenario 1, the assessment of historical deep percolation, and the effectiveness improved irrigation practices and passive water table management.

### Historical Deep Percolation and Scenario 1

For the sensitivity analysis performed on scenario 1 and the historical deep percolation, only the surface drainage selenium concentration was varied, the quantity of total and tile drainage and the total drainage concentration were held constant. As can be seen in equation (4), if all other variables are held constant, the tile drainage selenium concentration is dependent on the assumed surface drainage concentration. By specifying the surface drainage selenium concentration, the tile drainage selenium concentration is established. Three surface drainage concentrations are evaluated (0 µg/L, 2 µg/L, 10 µg/L). 0 µg/L selenium would be expected from pristine Sierran runoff; 2 µg/L represents the 64th percentile of the selenium concentration in the C.C.I.D. Main Canal at Russell Ave., 10 µg/L would represent the exclusive use of ground water of moderately good quality. Rearranging equation (4), the corresponding tile drainage concentrations for a fixed tile drainage flow (0.75 acre-ft x on 43,000 effectively drained acres in 1987), total drainage flow (73,700 acre-ft in 1987), total drainage concentration (53 µg/L Se in 1987), and surface drainage concentration would be:

(6) $C_{Tile} = [Q_{Total}*C_{Total} - (Q_{Total}-Q_{Tile})*C_{Surface}] / Q_{Tile}$

Table 3-5 presents the results of the calculations.

Table 3-6 compares the calculated historical deep percolation for the three assumed surface drainage selenium concentrations. Changing the surface drainage concentration has little effect on the calculated amount of tile drainage produced. The five-fold increase in the estimated surface drainage concentration produces at most a 9% increase in the estimated tile drainage produced in acre-feet/acre.

Tables 3-7 a, b, and c compare the effect of various assumed tile and surface drainage concentrations (from table 3-5) on the amount of load reduction expected - all other variables are held constant. As can be seen in tables 3-7 a, b, and c, the estimated final load produced after implementation of all three actions does not differ significantly for the variations in tile and surface drainage concentration considered.

### Improved Irrigation Practices and Passive Water Table Management

The estimated tile drainage concentration is used to determine the amount of load reduction that would occur with application of improved irrigation practices or passive water table management. Four different tile drainage concentrations are considered (100 μg/L, 120 μg/L, 140 μg/L, 200 μg/L). Note that if the tile drainage concentration is greater than 123 μg/L, the deep percolation assumed for 1987 must be less than 0.75 acre-ft/acre or else the calculated load would be greater than the observed load. In Figure 3-1, deep percolation reductions of greater than 0.45 acre-ft/acre are not considered for the 200 μg/L tile drainage concentration. The maximum tile drainage produced in 1987 would have been 0.46 acre-ft/acre at that concentration. In Figure 3-2, no more than 5,000 acres of trees are planted for the 200 μg/L tile drainage concentration since the selenium load produced in 1987 was 10,700 lbs.

Figure 3-1 plots the amount of selenium load reduced with respect to the effectiveness of improved irrigation practices and the selenium tile drainage concentration. Improved irrigation is applied to 43,000 effectively drained acres (effectively drained acres in production in 1987). As one would expect, improved irrigation is more effective in reducing loads for higher tile drainage concentrations. Figure 3-2 plots the amount of selenium load reduced with respect to the amount of acres of trees planted and the selenium tile drainage concentration. It is assumed that the ET rate of the trees is 4 acre-ft/acre. As with improved irrigation practices, passive water table management is more effective in reducing loads for higher tile drainage concentrations.

Two general conclusions can be drawn from Figures 3-1 and 3-2: 1) actions such as improved irrigation practices and passive water table management will be most cost effective when applied in areas with high selenium concentrations; and 2) if the actual tile drainage concentration is higher than assumed in the analysis of actions, less investment will be required to reduce selenium loads; if the actual tile drainage concentration is lower than assumed in the analysis of actions, more investment will be required to reduce selenium loads.

## CONCLUSIONS

This report evaluated the degree of selenium load reduction possible in the drainage problem area through application of some of the key components of the San Joaquin Valley Drainage Program. The agroforestry concept of the SJVDP was modified based on recent research which indicates that application of high salinity drainage to surface irrigate trees has disadvantages related to increased soil salinity, reduced ET, potential wildlife problems, and lack of disposal alternative for salts. Trees were used rather to tap directly into the ground water table.

Land retirement was selectively applied to those areas which produce the greatest selenium load and improved irrigation practices were applied to all areas which were not retired or converted to trees.

Recent research also indicates that selenium treatment may be viable at the plant scale. Two scenarios were evaluated based on the implementation of treatment rather than land retirement. This option would require the establishment of a treatment works equivalent to that required by a city the size of Los Banos (1.4 to 2.8 mgd).

Performance of a sensitivity analysis indicated that the assumed surface drainage concentration does not significantly change the calculated tile drainage production that occurred historically. The sensitivity analysis also showed that actions such as improved irrigation practices and passive water table management will be most cost effective when applied in areas with high selenium concentrations. It should also be noted that if the actual tile drainage concentration is higher than assumed in the analysis of actions, less investment will be required to reduce selenium loads; if the actual tile drainage concentration is lower than assumed in the analysis of actions, more investment will be required to reduce selenium loads.

The simple evaluation conducted indicates that selenium load reductions required to meet a 5 μg/L 4-day average selenium objective in the San Joaquin River in a dry year are technically achievable. Further, historical data indicates that the deep percolation reductions that were expected to be accomplished by improved irrigation practices may have been achieved, although the reductions have not been maintained.

Actions evaluated are not necessarily preferred actions, but are only presented to assess achievability of load reductions. This analysis evaluated some actions that are currently in the demonstration phase, so the assumed performance may not reflect the actual performance of these actions with wide-scale implementation. The choice of actions evaluated is not meant to imply economic feasibility. Some other actions or combination of actions may achieve reductions in a more technically effective and economical manner.

**Table 3-1. Load Reduction Scenario 1**

| | Base Case | Improved Irrigation Tile | Surface | Trees | Land Retirement |
|---|---|---|---|---|---|
| Tile Drained area (acres) | 47,500 | | | | |
| Total Effective tile drained acres | 52,800 | 46,800 | 52,800 | | |
| % of Land Fallowed | 18.5% | 18.5% | 18.5% | | |
| Surface Drainage (acre-ft/acre) | 0.96 | | 0 | | |
| Deep Percolation (acre-ft/acre) | 0.75 | 0.4 | | | |
| Reduction in Recharge (acre-ft/acre) | 0 | 0.35 | | 4 | |
| Acres Applied | 0 | 38,100 | 43,000 | 3,000 | 3,000 |
| Total Volume Reduction (acre-ft) | 0 | 13,300 | 41,300 | 12,000 | 2,250 |
| Selenium Load Reduction (lbs) | 0 | 4,300 | 220 | 3,880 | 1,400 |
| | | | | | |
| Total Selenium Load | 10,700 | 6,400 | 6,180 | 2,300 | 900 |

**Table 3-2. Load Reduction Scenario 2**

| | Base Case | Improved Irrigation Tile | Surface | Trees | Treatment |
|---|---|---|---|---|---|
| Tile Drained area (acres) | 47,500 | | | | |
| Total Effective tile drained acres | 52,800 | 49,800 | 52,800 | | |
| % of Land Fallowed | 18.5% | 18.5% | 18.5% | | |
| Surface Drainage (acre-ft/acre) | 0.96 | | 0 | | |
| Deep Percolation (acre-ft/acre) | 0.75 | 0.4 | | | |
| Reduction in Recharge (acre-ft/acre) | 0 | 0.35 | | 4 | |
| Acres Applied | 0 | 40,600 | 43,032 | 3,000 | |
| Total Volume Reduction (acre-ft) | 0 | 14,200 | 41,300 | 12,000 | 0 |
| Selenium Load Reduction (lbs) | 0 | 4,600 | 220 | 3,880 | 1,100 |
| | | | | | |
| Total Selenium Load | 10,700 | 6,100 | 5,880 | 2,000 | 900 |

Volume of drainage treated to reduce selenium load by amount indicated
(assuming 300 μg/L to 50 μg/L reduction) = 1620 acre-ft

**Table 3-3. Load Reduction Scenario 3**

| | Base Case | Improved Irrigation Tile | Surface | Trees | Treatment |
|---|---|---|---|---|---|
| Tile Drained area (acres) | 47,500 | | | | |
| Total Effective tile drained acres | 52,800 | 49,800 | 52,800 | | |
| % of Land Fallowed | 5.0% | 5.0% | 5.0% | | |
| Surface Drainage (acre-ft/acre) | 0.96 | | 0 | | |
| Deep Percolation (acre-ft/acre) | 0.75 | 0.4 | | | |
| Reduction in Recharge (acre-ft/acre) | 0 | 0.35 | | 4 | |
| Acres Applied | 0 | 47,300 | 50,160 | 3,000 | |
| Total Volume Reduction (acre-ft) | 0 | 16,600 | 48,200 | 12,000 | 0 |
| Selenium Load Reduction (lbs) | 0 | 5,370 | 260 | 3,880 | 1,990 |
| | | | | | |
| Total Selenium Load | 12,400 | 7,030 | 6,770 | 2,890 | 900 |

Volume of drainage treated to reduce selenium load by amount indicated
(assuming 300 μg/L to 50 μg/L reduction) = 2930 acre-ft

## Table 3-4

| Water Year | Se Load lbs. | Land in Production Acres | Total Drainage Acre-ft | Total Drainage Se (µg/L) | Tile Drainage Acre-ft | Acre-ft/ Irrigated Drained Acre Total Drainage | Acre-ft/ Irrigated Drained Acre Tile Drainage | % Tile |
|---|---|---|---|---|---|---|---|---|
| 1986 | 9,720 | 65,200 | 70,100 | 51 | 29,400 | 1.66 | 0.70 | 42% |
| 1987 | 10,700 | 66,400 | 73,700 | 53 | 32,100 | 1.71 | 0.75 | 44% |
| 1988 | 10,100 | 73,900 | 65,300 | 57 | 30,700 | 1.36 | 0.64 | 47% |
| 1989 | 8,810 | 73,600 | 54,200 | 60 | 26,900 | 1.14 | 0.56 | 50% |
| 1990 | 7,480 | 72,000 | 41,700 | 66 | 22,800 | 0.89 | 0.49 | 55% |
| 1991 | 6,120 | 68,600 | 30,000 | 75 | 18,700 | 0.67 | 0.42 | 62% |
| 1992 | 5,160 | 66,300 | 24,600 | 77 | 15,800 | 0.57 | 0.37 | 64% |
| 1993 | 8,850 | 74,700 | 40,400 | 81 | 27,300 | 0.83 | 0.56 | 68% |
| 1994 | 8,510 | 79,700 | 38,000 | 82 | 26,000 | 0.74 | 0.50 | 68% |

| | |
|---|---|
| Tile Drained area | 47,500 |
| Total Effective tile drained acres | 52,800 |
| Total Irrigable Acres | 81,446 |
| Percent of Contribution of upslope area to drain recharge | 10% |
| Concentration of Se in Tile Drainage = | 119 µg/L |
| Concentration of Se in Tail Water = | 2 µg/L |
| Conversion acre-ft x µg/L to lbs = | 0.00272 |

## Table 3-5

Surface Drainage and Tile Drainage Selenium Concentration Used for Sensitivity Analysis with Constant Total and Tile Drainage Flow and Constant Total Drainage Selenium Concentration

| Assumed Surface Drainage Se Concentration (μg/L) | Calculated Tile Drainage Se Concentration (μg/L) |
|---|---|
| 0 | 121 |
| 2 | 119 |
| 10 | 108 |

## Table 3-6

Tile Drainage Produced in Acre-Ft/ Acre in the Drainage Problem Area for Different Assumed Selenium Concentrations in Surface Drainage

| Water Year | Se (μg/L) in Surface Drainage | | |
|---|---|---|---|
| | 0 | 2 | 10 |
| 1986 | 0.70 | 0.70 | 0.69 |
| 1987 | 0.75 | 0.75 | 0.75 |
| 1988 | 0.64 | 0.64 | 0.65 |
| 1989 | 0.56 | 0.56 | 0.58 |
| 1990 | 0.49 | 0.49 | 0.51 |
| 1991 | 0.42 | 0.42 | 0.45 |
| 1992 | 0.37 | 0.37 | 0.39 |
| 1993 | 0.56 | 0.56 | 0.61 |
| 1994 | 0.50 | 0.50 | 0.54 |

## Table 3-7 a

Load Reduction Scenario 1 - Tile Se = 119 µg/L; Surface Se = 2 µg/L

| | Base Case | Improved Irrigation Tile | Improved Irrigation Surface | Trees | Land Retirement |
|---|---|---|---|---|---|
| Tile Drained area (acres) | 47,500 | | | | |
| Total Effective tile drained acres | 52,800 | 46,800 | 52,800 | | |
| % of Land Fallowed | 18.5% | 18.5% | 18.5% | | |
| Surface Drainage (acre-ft/acre) | 0.96 | | 0 | | |
| Deep Percolation (acre-ft/acre) | 0.75 | 0.4 | | | |
| Reduction in Recharge (acre-ft/acre) | 0 | 0.35 | | 4 | |
| Acres Applied | 0 | 38,100 | | 3,000 | 3,000 |
| Total Volume Reduction (acre-ft) | 0 | 13,300 | 41,300 | 12,000 | 2,250 |
| Selenium Load Reduction (lbs) | 0 | 4,300 | 220 | 3,880 | 1,400 |
| Total Selenium Load | 10,700 | 6,400 | 6,180 | 2,300 | 900 |

Concentration of Selenium in Tile Drainage = 119 µg/L
Concentration of Selenium in Surface Drainage = 2 µg/L
Conversion acre-ft x µg/L to lbs = 0.00272
Percent of Contribution of upslope area to drain recharge 10%

## Table 3-7 b

Load Reduction Scenario 1 - Tile Se = 121 µg/L; Surface Se = 0 µg/L

| | Base Case | Improved Irrigation Tile | Improved Irrigation Surface | Trees | Land Retirement |
|---|---|---|---|---|---|
| Tile Drained area (acres) | 47,500 | | | | |
| Total Effective tile drained acres | 52,800 | 46,800 | 52,800 | | |
| % of Land Fallowed | 18.5% | 18.5% | 18.5% | | |
| Surface Drainage (acre-ft/acre) | 0.96 | | 0 | | |
| Deep Percolation (acre-ft/acre) | 0.75 | 0.4 | | | |
| Reduction in Recharge (acre-ft/acre) | 0 | 0.35 | | 4 | |
| Acres Applied | 0 | 38,100 | | 3,000 | 3,000 |
| Total Volume Reduction (acre-ft) | 0 | 13,300 | 41,300 | 12,000 | 2,251 |
| Selenium Load Reduction (lbs) | 0 | 4,380 | 0 | 3,950 | 1,400 |
| Total Selenium Load | 10,600 | 6,220 | 6,220 | 2,270 | 870 |

Concentration of Selenium in Tile Drainage = 121 µg/L
Concentration of Selenium in Surface Drainage = 0 µg/L

## Table 3-7 c

Load Reduction Scenario 1 - Tile Se = 108 µg/L; Surface Se = 10 µg/L

| | Base Case | Improved Irrigation Tile | Improved Irrigation Surface | Trees | Land Retirement |
|---|---|---|---|---|---|
| Tile Drained area (acres) | 47,500 | | | | |
| Total Effective tile drained acres | 52,800 | 46,800 | 52,800 | | |
| % of Land Fallowed | 18.5% | 18.5% | 18.5% | | |
| Surface Drainage (acre-ft/acre) | 0.96 | | 0 | | |
| Deep Percolation (acre-ft/acre) | 0.75 | 0.4 | | | |
| Reduction in Recharge (acre-ft/acre) | 0 | 0.35 | | 4 | |
| Acres Applied | 0 | 38,100 | | 3,000 | 3,000 |
| Total Volume Reduction (acre-ft) | 0 | 13,300 | 41,300 | 12,000 | 2,250 |
| Selenium Load Reduction (lbs) | 0 | 3,910 | 1,120 | 3,530 | 1,400 |
| Total Selenium Load | 10,600 | 6,690 | 5,570 | 2,040 | 640 |

Concentration of Selenium in Tile Drainage = 108 µg/L
Concentration of Selenium in Surface Drainage = 10 µg/L

**Figure 3-1. Selenium Load Reduction versus Effectiveness of Improved Irrigation (applied to 43,0000 effectively drained acres) and Se Tile Drainage Concentration**

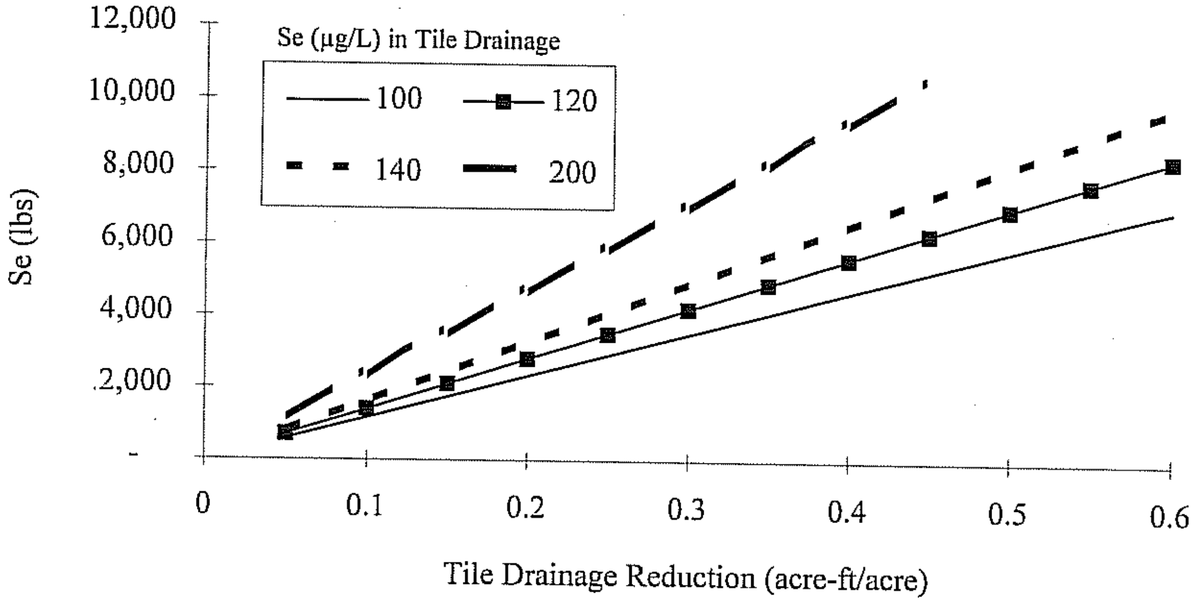
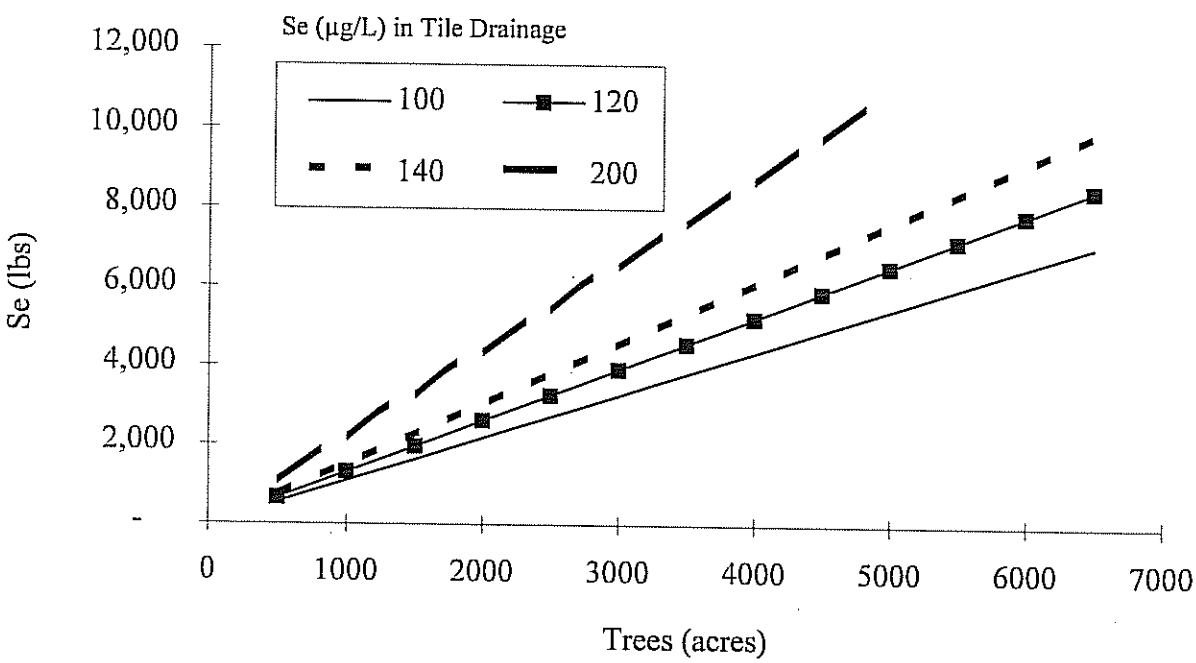



**Figure 3-2. Selenium Load Reduction versus Trees Planted (ET=4 acre-ft/acre) and Se Tile Drainage Concentration**



## SUPPLEMENTAL INFORMATION

### Calculation of Acres of Land in Production

In order to assess changes in total drainage and tile drainage on a per acre basis it is necessary to know the amount of land in production in a given year. Cal Poly in their 1994 report (Table 3-1) provide data on the acreage of various crops and fallowed acreage. Crops that were double cropped are not accounted for separately, but are included in this table. Information on the amount of land double cropped is not available for most years, so estimates will be made of double cropped acreage based on crop type. It will be assumed that the crops most conducive to double cropping are wheat, barley, and sugar beets and that half of the planted acreage of these crops is double cropped.

For 1993 and 1994, total cropped area information was provided by the Districts in the drainage problem area to the Regional Board. CCID's Camp 13 area and Charleston Drainage District were estimated based on data for all of CCID and all of San Luis Water District, respectively. Information on double cropping was available for 1994. For 1993, it is assumed that the percentage of double cropping was the same as 1991 and 1992 - about 4%.

### TABLE 3-8

### Land in Production in the Drainage Problem Area

| | Area in Acres | | | |
|---|---|---|---|---|
| Water Year | Total Cropped Area | Double Cropped Area | Area in Production | % of Irrigable Acres |
| 1986 | 72,084 | 6,929 | 65,200 | 80.1% |
| 1987 | 73,883 | 7,475 | 66,400 | 81.5% |
| 1988 | 78,793 | 4,881 | 73,900 | 90.7% |
| 1989 | 80,434 | 6,877 | 73,600 | 90.4% |
| 1990 | 77,601 | 5,623 | 72,000 | 88.4% |
| 1991 | 71,157 | 2,579 | 68,600 | 84.2% |
| 1992 | 69,614 | 3,307 | 66,300 | 81.4% |
| 1993 | 77,985 | 3,266 | 74,700 | 91.7% |
| 1994 | 82,604 | 2,918 | 79,700 | 97.9% |

# APPENDIX 4

# DRAFT TMDL SUBMITTAL TO THE U.S. EPA FOR SELENIUM IN THE SAN JOAQUIN RIVER

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
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Alexis Strauss, Acting Division Director
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U.S. EPA, Region IX
75 Hawthorne St.
San Francisco, CA 94105

**SUBJECT: TMDL SUBMITTAL FOR SELENIUM IN THE SAN JOAQUIN RIVER**

Section 303(d) of the Federal Clean Water Act requires the development of a Total Maximum Daily Load (TMDL) where existing effluent limitations are not stringent enough to meet water quality standards. The Central Valley Regional Water Quality Control Board (Regional Board) has identified the San Joaquin River as a water quality limited segment with respect to selenium. The Regional Board has also given priority to development of a selenium TMDL for the San Joaquin River.

The water rights phase of implementation of the Bay/Delta standards may result in an alteration of the San Joaquin River's hydrology. Therefore, a phased approach to implementation of the TMDL will be used. The Regional Board is submitting for your consideration an initial TMDL for selenium in the San Joaquin River below the Merced River. The effluent limits described in the attached tables may be modified during the Regional Board's considerations of waste discharge requirements for the Drainage Problem Area. If modifications are made, the Regional Board will submit a revised TMDL to the U.S. EPA for approval.

The load allocations described through water year 2000 are based on the recommended load limits in the consensus letter written to the Regional Board from the U.S. EPA, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and San Luis & Delta-Mendota Water Authority (Table 1A). The load allocations which apply after water year 2000, were derived from two technical reports which were used as the basis for determining the Total Maximum Monthly Load (TMML) for meeting performance goals and selenium water quality objectives in the San Joaquin River downstream of the Merced River (Karkoski, et al, 1993; Karkoski, 1994).

A 22 year flow record was used to assess the assimilative capacity (the TMML) of the San Joaquin River at Crows Landing, as described in the aforementioned reports. The TMML was then apportioned to a margin of safety (10% of the TMML), background sources (see Tables 2A & 2B), and a load allocation for the Drainage Problem Area in the Grassland watershed. There are no significant sources of selenium from point sources, so no waste load allocation was assigned.

The calculated load allocation for the Drainage Problem Area presented in the attached tables differs from that described in the reports, since the reports considered three water year type categories and only two water year type categories are now being considered (dry and wet water year types). The load allocation will be incorporated into waste discharge requirements upon final approval of the Basin Plan Amendment for agricultural subsurface drainage discharges. The waste discharge requirements will be issued to a

Regional Drainage Authority or to the individual agricultural districts in the absence of a Regional Drainage Authority. Note that there is a maximum compliance time period for the effluent limits described in tables 1B and 1C. A shorter time frame may apply if the Regional Board determines that such a time frame is technically and economically feasible.

The Regional Board currently conducts a comprehensive monitoring program in the Grassland watershed and San Joaquin River. In addition to the Regional Board's monitoring of receiving waters, the dischargers in the Drainage Problem Area will be required to monitor the effectiveness of their drainage management activities and provide an annual report. The data collected as a part of the monitoring programs will be used to determine the appropriateness of the TMDL submitted to the U.S. EPA. The first scheduled review of the TMDL will take place concurrently with the consideration of waste discharge requirements - in approximately one year from the date of adoption of the Basin Plan Amendments by the Regional Board. The next scheduled review of the TMDL will take place no later than June 30, 1999. Based on these reviews the TMDL may be modified and resubmitted to the U.S. EPA as appropriate. Data assessment and TMDL validation will take place at least once every five years thereafter. Further model development may be required depending on the outcome of the data assessment and TMDL validation.

The Regional Board has made this letter and supporting discussion available for public review and comment as part of amendment of the Basin Plan. If you have any questions, please call me or Dennis Westcot at (916) 255-3000.

WILLIAM H. CROOKS
Executive Officer

Enclosure

**Table 1A. Monthly and Annual Load Allocation (pounds of selenium) for the Drainage Problem Area Based on the Consensus Letter signed by U.S. EPA, U.S. Bureau of Reclamation, U.S. Fish & Wildlife Service, and San Luis & Delta-Mendota Water Authority**

| Month | Effluent Limits which apply 10/95-9/97 | Effluent Limits which apply 10/97-9/98 | Effluent Limits which apply 10/98-9/99 | Effluent Limits which apply 10/99-9/00 |
|---|---|---|---|---|
| September | 350 | 350 | 350 | 350 |
| October | 348 | 348 | 348 | 348 |
| November | 348 | 348 | 348 | 348 |
| December | 389 | 389 | 389 | 389 |
| January | 533 | 506 | 479 | 453 |
| February | 866 | 823 | 779 | 736 |
| March | 1066 | 1013 | 959 | 906 |
| April | 799 | 759 | 719 | 679 |
| May | 666 | 633 | 599 | 566 |
| June | 599 | 569 | 539 | 509 |
| July | 599 | 569 | 539 | 509 |
| August | 533 | 506 | 480 | 453 |
| Max. Annual | 6660 | 6327 | 5994 | 5661 |

## Monthly Load Allocation (pounds of selenium) for the Drainage Problem Area Based on Applicable Performance Goals and a 5 $\mu$g/L 4-day Average Selenium Objective for the San Joaquin River at Crows Landing

### Table 1B. Dry Year[1] (C/D/BN)

| Month | Effluent Limits which apply no later than 1 October 2002 [2] | Effluent Limits which apply no later than 1 October 2005 [3] | Effluent Limits which apply no later than 1 October 2010 [4] |
|---|---|---|---|
| October | 114 | 69 | 41 |
| November | 114 | 69 | 41 |
| December | 303 | 186 | 131 |
| January | 302 | 186 | 131 |
| February | 284 | 169 | 99 |
| March | 284 | 169 | 98 |
| April | 293 | 178 | 107 |
| May | 296 | 181 | 111 |
| June | 126 | 76 | 64 |
| July | 127 | 77 | 65 |
| August | 132 | 83 | 70 |
| September | 116 | 71 | 43 |

### Table 1C. Wet Year[1] (AN/W)

| Month | Effluent Limits which apply no later than 1 October 2002 [3] | Effluent Limits which apply no later than 1 October 2005 [4] |
|---|---|---|
| October | 328 | 260 |
| November | 328 | 260 |
| December | 461 | 211 |
| January | 461 | 211 |
| February | 432 | 297 |
| March | 432 | 297 |
| April | 450 | 315 |
| May | 457 | 322 |
| June | 262 | 212 |
| July | 264 | 214 |
| August | 274 | 225 |
| September | 332 | 264 |

[1] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level (Department of Water Resources Bulletin 120). The previous water year's classification will apply until an estimate is made of the current water year.

[2] Effluent limits required to meet an 8 µg/L monthly mean performance goal at a frequency of violation of no greater than once every three years.

[3] Effluent limits required to meet a 5 µg/L monthly mean performance goal at a frequency of violation of no greater than once every three years.

[4] Effluent limits required to meet a 5 µg/L 4-day average water quality objective at a frequency of violation of no greater than once every three years.

Table 2A

Detailed Breakdown of the Allocation of the Total Maximum Monthly Load for Selenium in the San Joaquin River at Crows Landing to meet an 8 µg/L Monthly Mean Performance Goal with a One in Three year Violation Rate

| Time Period | Year Type | Monthly Mean Performance Goal µg/L 1 | SJR @ Crows Flow Acre-Ft 2 | TMML 1x2 lbs 3 | Merced River Acre-Ft 4 | Merced Conc. µg/L 5 | SJR@ Lander Acre-Ft 6 | SJR@ Lander Conc. µg/L 7 | Wet-land Flow Acre-Ft 8 | Wet-land Conc µg/L 9 | Bkgnd Load 4x5+6x7 +8x9 lbs 10 | MOS (3) x 10% lbs 11 | LA DPA 3-10-11 lbs 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct | C/D/BN | 8 | 6,088 | 132 | 699 | 0.2 | 105 | 0.5 | 1,700 | 1 | 5 | 13 | 114 |
| Nov | C/D/BN | 8 | 6,088 | 132 | 699 | 0.2 | 105 | 0.5 | 1,700 | 1 | 5 | 13 | 114 |
| Dec | C/D/BN | 8 | 15,911 | 346 | 7,811 | 0.2 | 23 | 0.5 | 1,600 | 1 | 9 | 35 | 303 |
| Jan | C/D/BN | 8 | 15,911 | 346 | 7,811 | 0.2 | 23 | 0.5 | 1,700 | 1 | 9 | 35 | 302 |
| Feb | C/D/BN | 8 | 15,678 | 341 | 4,000 | 0.2 | 519 | 0.5 | 7,200 | 1 | 22 | 34 | 284 |
| Mar | C/D/BN | 8 | 15,678 | 341 | 4,000 | 0.2 | 519 | 0.5 | 7,300 | 1 | 23 | 34 | 284 |
| Apr | C/D/BN | 8 | 15,678 | 341 | 4,000 | 0.2 | 519 | 0.5 | 4,000 | 1 | 14 | 34 | 293 |
| May | C/D/BN | 8 | 15,678 | 341 | 4,000 | 0.2 | 519 | 0.5 | 2,700 | 1 | 10 | 34 | 296 |
| Jun | C/D/BN | 8 | 6,804 | 148 | 1,000 | 0.2 | 58 | 0.5 | 2,400 | 1 | 7 | 15 | 126 |
| Jul | C/D/BN | 8 | 6,804 | 148 | 1,000 | 0.2 | 58 | 0.5 | 2,000 | 1 | 6 | 15 | 127 |
| Aug | C/D/BN | 8 | 6,804 | 148 | 1,000 | 0.2 | 58 | 0.5 | 0 | 1 | 1 | 15 | 132 |
| Sept | C/D/BN | 8 | 6,088 | 132 | 699 | 0.2 | 105 | 0.5 | 1,000 | 1 | 3 | 13 | 116 |

Conversion Acre-ft x µg/L to lbs. 0.00272 Margin of Safety (MOS) 10%

Abbreviations Key

C/D/BN - San Joaquin River water year type classification; C-Critically Dry; D-Dry; BN-Below Normal
SJR @ Crows - San Joaquin River @ Crows Landing Road
SJR @ Lander - San Joaquin River @ Lander Avenue
Wetland - Discharges from the wetlands
Bkgnd Load - Background load
LA DPA - load allocation for the Drainage Problem Area

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Table 2B

Detailed Breakdown of the Allocation of the Total Maximum Monthly Load for Selenium in the San Joaquin River at Crows Landing to meet an 5 µg/L Monthly Mean Performance Goal with a One in Three year Violation Rate

| Time Period | Year Type | Monthly Mean Performance Goal µg/L 1 | SJR @ Crows Flow Acre-Ft 2 | TMML 1x2 lbs 3 | Merced River Acre-Ft 4 | Merced Conc. µg/L 5 | SJR@ Lander Acre-Ft 6 | SJR@ Lander Conc. µg/L 7 | Wet-land Flow Acre-Ft 8 | Wet-land Conc µg/L 9 | Bkgnd Load 4x5+6x7 +8x9 lbs 10 | MOS (3) x 10% lbs 11 | LA DPA 3-10-11 lbs 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct | C/D/BN | 5 | 6,088 | 83 | 699 | 0.2 | 105 | 0.5 | 1,700 | 1 | 5 | 8 | 69 |
| Oct | AN/W | 5 | 28,400 | 386 | 13,430 | 0.2 | 2,188 | 0.5 | 3,300 | 1 | 19 | 39 | 328 |
| Nov | C/D/BN | 5 | 6,088 | 83 | 699 | 0.2 | 105 | 0.5 | 1,700 | 1 | 5 | 8 | 69 |
| Nov | AN/W | 5 | 28,400 | 386 | 13,430 | 0.2 | 2,188 | 0.5 | 3,300 | 1 | 19 | 39 | 328 |
| Dec | C/D/BN | 5 | 15,911 | 216 | 7,811 | 0.2 | 23 | 0.5 | 1,600 | 1 | 9 | 22 | 186 |
| Dec | AN/W | 5 | 39,445 | 536 | 14,060 | 0.2 | 3,488 | 0.5 | 3,200 | 1 | 21 | 54 | 461 |
| Jan | C/D/BN | 5 | 15,911 | 216 | 7,811 | 0.2 | 23 | 0.5 | 1,700 | 1 | 9 | 22 | 186 |
| Jan | AN/W | 5 | 39,445 | 536 | 14,060 | 0.2 | 3,488 | 0.5 | 3,300 | 1 | 21 | 54 | 461 |
| Feb | C/D/BN | 5 | 15,678 | 213 | 4,000 | 0.2 | 519 | 0.5 | 7,200 | 1 | 22 | 21 | 169 |
| Feb | AN/W | 5 | 39,870 | 542 | 13,480 | 0.2 | 6,278 | 0.5 | 14,400 | 1 | 55 | 54 | 432 |
| Mar | C/D/BN | 5 | 15,678 | 213 | 4,000 | 0.2 | 519 | 0.5 | 7,300 | 1 | 23 | 21 | 169 |
| Mar | AN/W | 5 | 39,870 | 542 | 13,480 | 0.2 | 6,278 | 0.5 | 14,400 | 1 | 55 | 54 | 432 |
| Apr | C/D/BN | 5 | 15,678 | 213 | 4,000 | 0.2 | 519 | 0.5 | 4,000 | 1 | 14 | 21 | 178 |
| Apr | AN/W | 5 | 39,870 | 542 | 13,480 | 0.2 | 6,278 | 0.5 | 7,800 | 1 | 37 | 54 | 450 |
| May | C/D/BN | 5 | 15,678 | 213 | 4,000 | 0.2 | 519 | 0.5 | 2,700 | 1 | 10 | 21 | 181 |
| May | AN/W | 5 | 39,870 | 542 | 13,480 | 0.2 | 6,278 | 0.5 | 5,300 | 1 | 30 | 54 | 457 |
| Jun | C/D/BN | 5 | 6,804 | 92 | 1,000 | 0.2 | 58 | 0.5 | 2,400 | 1 | 7 | 9 | 76 |
| Jun | AN/W | 5 | 23,000 | 312 | 8,960 | 0.2 | 1,615 | 0.5 | 4,600 | 1 | 20 | 31 | 262 |
| Jul | C/D/BN | 5 | 6,804 | 92 | 1,000 | 0.2 | 58 | 0.5 | 2,000 | 1 | 6 | 9 | 77 |
| Jul | AN/W | 5 | 23,000 | 312 | 8,960 | 0.2 | 1,615 | 0.5 | 3,900 | 1 | 18 | 31 | 264 |
| Aug | C/D/BN | 5 | 6,804 | 92 | 1,000 | 0.2 | 58 | 0.5 | 0 | 1 | 1 | 9 | 83 |
| Aug | AN/W | 5 | 23,000 | 312 | 8,960 | 0.2 | 1,615 | 0.5 | 0 | 1 | 7 | 31 | 274 |
| Sept | C/D/BN | 5 | 6,088 | 83 | 699 | 0.2 | 105 | 0.5 | 1,000 | 1 | 3 | 8 | 71 |
| Sept | AN/W | 5 | 28400 | 386 | 13430 | 0 | 2188 | 1 | 1900 | 1 | 15 | 39 | 332 |

Conversion Acre-ft x µg/L to lbs. 0.00272 Margin of Safety (MOS) 10%

Abbreviations Key

C/D/BN - San Joaquin River water year type classification; C-Critically Dry; D-Dry; BN-Below Normal
SJR @ Crows - San Joaquin River @ Crows Landing Road
SJR @ Lander - San Joaquin River @ Lander Avenue
Wetland - Discharges from the wetlands
Bkgnd Load - Background load
LA DPA - load allocation for the Drainage Problem Area

## Table 2C

Detailed Breakdown of the Allocation of the Total Maximum Monthly Load for Selenium in the San Joaquin River at Crows Landing to meet an 5 µg/L 4-Day Average Water Quality Objective with a One in Three year Violation Rate

| Time Period | Year Type | 4-Day Average Water Quality Objective µg/L 1 | SJR @ Crows Flow Acre-Ft 2 | TMML 1x2 lbs 3 | Merced River Acre-Ft 4 | Merced Conc. µg/L 5 | SJR@ Lander Acre-Ft 6 | SJR@ Lander Conc. µg/L 7 | Wet-land Flow Acre-Ft 8 | Wet-land Conc µg/L 9 | Bkgnd Load 4x5+6x7 +8x9 lbs 10 | MOS (3) x 10% lbs 11 | LA DPA 3-10-11 lbs 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct | C/D/BN | 5 | 3,883 | 53 | 3,242 | 0.2 | 121 | 0.5 | 1,700 | 1 | 7 | 5 | 41 |
| Oct | AN/W | 5 | 22,667 | 308 | 10,719 | 0.2 | 1,746 | 0.5 | 3,300 | 1 | 17 | 31 | 260 |
| Nov | C/D/BN | 5 | 3,883 | 53 | 3,242 | 0.2 | 121 | 0.5 | 1,700 | 1 | 7 | 5 | 41 |
| Nov | AN/W | 5 | 22,667 | 308 | 10,719 | 0.2 | 1,746 | 0.5 | 3,300 | 1 | 17 | 31 | 260 |
| Dec | C/D/BN | 5 | 11,517 | 156 | 8,630 | 0.2 | 472 | 0.5 | 1,600 | 1 | 10 | 16 | 131 |
| Dec | AN/W | 5 | 19,260 | 262 | 4,981 | 0.2 | 9,616 | 0.5 | 3,200 | 1 | 24 | 26 | 211 |
| Jan | C/D/BN | 5 | 11,517 | 156 | 8,630 | 0.2 | 472 | 0.5 | 1,700 | 1 | 10 | 16 | 131 |
| Jan | AN/W | 5 | 19,260 | 262 | 4,981 | 0.2 | 9,616 | 0.5 | 3,300 | 1 | 25 | 26 | 211 |
| Feb | C/D/BN | 5 | 9,787 | 133 | 2,502 | 0.2 | 85 | 0.5 | 7,200 | 1 | 21 | 13 | 99 |
| Feb | AN/W | 5 | 28,405 | 386 | 9,604 | 0.2 | 4,473 | 0.5 | 14,400 | 1 | 50 | 39 | 297 |
| Mar | C/D/BN | 5 | 9,787 | 133 | 2,502 | 0.2 | 85 | 0.5 | 7,300 | 1 | 21 | 13 | 98 |
| Mar | AN/W | 5 | 28,405 | 386 | 9,604 | 0.2 | 4,473 | 0.5 | 14,400 | 1 | 50 | 39 | 297 |
| Apr | C/D/BN | 5 | 9,787 | 133 | 2,502 | 0.2 | 85 | 0.5 | 4,000 | 1 | 12 | 13 | 107 |
| Apr | AN/W | 5 | 28,405 | 386 | 9,604 | 0.2 | 4,473 | 0.5 | 7,800 | 1 | 32 | 39 | 315 |
| May | C/D/BN | 5 | 9,787 | 133 | 2,502 | 0.2 | 85 | 0.5 | 2,700 | 1 | 9 | 13 | 111 |
| May | AN/W | 5 | 28,405 | 386 | 9,604 | 0.2 | 4,473 | 0.5 | 5,300 | 1 | 26 | 39 | 322 |
| Jun | C/D/BN | 5 | 5,808 | 79 | 872 | 0.2 | 51 | 0.5 | 2,400 | 1 | 7 | 8 | 64 |
| Jun | AN/W | 5 | 18,877 | 256 | 7,354 | 0.2 | 1,326 | 0.5 | 4,600 | 1 | 18 | 26 | 212 |
| Jul | C/D/BN | 5 | 5,808 | 79 | 872 | 0.2 | 51 | 0.5 | 2,000 | 1 | 6 | 8 | 65 |
| Jul | AN/W | 5 | 18,877 | 256 | 7,354 | 0.2 | 1,326 | 0.5 | 3,900 | 1 | 16 | 26 | 214 |
| Aug | C/D/BN | 5 | 5,808 | 79 | 872 | 0.2 | 51 | 0.5 | 0 | 1 | 1 | 8 | 70 |
| Aug | AN/W | 5 | 18,877 | 256 | 7,354 | 0.2 | 1,326 | 0.5 | 0 | 1 | 6 | 26 | 225 |
| Sept | C/D/BN | 5 | 3,883 | 53 | 3,242 | 0.2 | 121 | 0.5 | 1,000 | 1 | 5 | 5 | 43 |
| Sept | AN/W | 5 | 22,667 | 308 | 10,719 | 0.2 | 1,746 | 0.5 | 1,900 | 1 | 13 | 31 | 264 |

Conversion Acre-ft x µg/L to lbs. 0.00272 Margin of Safety (MOS) 10%

Abbreviations Key

C/D/BN - San Joaquin River water year type classification; C-Critically Dry; D-Dry; BN-Below Normal
SJR @ Crows - San Joaquin River @ Crows Landing Road
SJR @ Lander - San Joaquin River @ Lander Avenue
Wetland - Discharges from the wetlands
Bkgnd Load - Background load
LA DPA - load allocation for the Drainage Problem Area

## References


Karkoski, J., Young, T., Congdon, C. and Haith, D.A., 1993. *Development of a Selenium TMDL for the San Joaquin River*. Management of Irrigation and Drainage Systems. Irrig. and Drainage Systems Div./ASCE; July 21-23, 1993, Park City, Utah.

Karkoski, J., 1994. *A Total Maximum Monthly Load Model for the San Joaquin River*. California Regional Water Quality Control Board, Central Valley Region.

# APPENDIX 5

# STATE WATER RESOURCES CONTROL BOARD REVIEW OF ECONOMIC ANALYSIS

State of California

JK

# Memorandum

**To:** 1. Barbara L. Evoy, Chief
Office of Statewide Consistency

2. Dennis Westcot
RWQCB, Central Valley Region

**Date:** December 4, 1995

Adrian Griffin, Senior Economist
Economics Unit, Office of Statewide Consistency

**From:** **STATE WATER RESOURCES CONTROL BOARD**
**901 P Street, Sacramento, California 95814**
**Mail Code G-8**

**Subject:** REVIEW OF ECONOMIC IMPACTS OF RESTRICTIONS ON SELENIUM DISCHARGES

In response a your request, I have reviewed *Potential Economic Impacts of Selenium Load Restrictions in the Grassland Basin*, a Report for the Grassland Basin Drainers by Dennis Wichelns and Laurie Houston, October 18, 1995 (Grassland Drainers' Report).

***Summary of Analysis***

The report provides a useful framework for examining the costs resulting from changes in irrigation practice, but does not give a complete answer to the question "What are the economic impacts of reducing discharges of selenium into the San Joaquin River?" The major limitation of the analysis is that it is done on a district-wide basis, so does not examine the effect on costs of variation in selenium concentrations from field to field. Costs are likely to be lower if acreage generating high selenium loads were fallowed or managed more intensively.

The analysis, discussed in more detail in the next section, uses an agricultural production model to estimate the cost of reducing selenium loads. The model allows growers to change crops and irrigation systems in order to reduce the flow of drainage water. The concentration of selenium in drainage water is assumed to be the same throughout each district. Costs occur as growers shift to more expensive irrigation systems, use drainage water for irrigation, which reduces yields, and shift to less-profitable, salt-tolerant crops.

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The report presents a variety of economic impacts, such as effects on employment and gross farm revenues. However, these figures do not directly indicate the costs imposed on growers by the load restrictions. Costs are best measured by impacts on net revenues. These figures, provided by the author of the report, show that the cost of reducing selenium loads in the way indicated by the production model ranges from $750 to $1,600 per pound.

Information in the RWQCB *Staff Report on Water Quality Objectives and Implementation Plan to be Used for the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin River Basin* shows that in some areas, selenium loads can be reduced at relatively low cost by land retirement or treatment of drainage water. For example, 1,400 pounds of selenium are generated annually by 3,000 acres drained by the five sumps producing the highest selenium loads. If this acreage were rented for $150 per acre and fallowed, the cost of removing selenium would be $320 per pound. Treatment of drainage water is estimated to cost $440 per pound (*Staff Report*, p. B-4). Fallowing acreage would also free water for use elsewhere. In dry years, funds received for transferring water could be used to offset the cost of renting or buying land for fallowing.

The cheapest way of meeting the discharge requirement is likely to be a combination of land fallowing, drainage water treatment, and changes in irrigation practice. Analysis on a field-by-field or sump-by-sump basis would be needed to show the effect on costs of fallowing or intensive management of acreage generating high selenium loads.

The Grassland Drainers' Report also discusses the regional economic impacts of the drop in agricultural output indicated by the production model results. Impacts on gross output and employment in Merced County are estimated by applying multipliers developed using an input-output model. For the reasons explained in the following section, these figures must be treated with caution.

### *Details of the Grassland Drainers' Analysis*

***Scenarios Examined.*** The study examines the effect of two selenium concentration objectives in a series of wet and normal years and in a series of dry years when the concentration objective results in lower loadings. The two series are intended to indicate the range of the impacts of each the concentration objectives. In addition, the report examines the impact of reducing discharges as specified in the Draft Use Agreement. The five scenarios examined are listed in the table below. Note that the frequency of exceedence is once in five months, rather than the once in three years specified in the USEPA's standards.

**Scenarios Examined in the Grassland Drainers' Study**

| Scenario | Total annual discharge (pounds) | Impacts in fifth year | |
|---|---|---|---|
| | | Net revenue ($ million) | Regional job displacement |
| Discharges meeting a 10 ppb objective, one exceedence in 5 months | | | |
| Series of 5 normal and wet years | 11,980 | 1.3 | 70 |
| Series of 5 critical and dry years | 6,010 | 5.8 | 500 |
| Discharges meeting a 5 ppb objective, one exceedence in 5 months | | | |
| Series of 5 normal and wet years | 5,800 | 6.3 | 550 |
| Series of 5 critical and dry years | 2,940 | 10.8 | 990 |
| Series of 5 years with the Draft Use Agreement | Falls from 6,660 in the first year to 5,660 in the fifth year. | 5.7 | 490 |

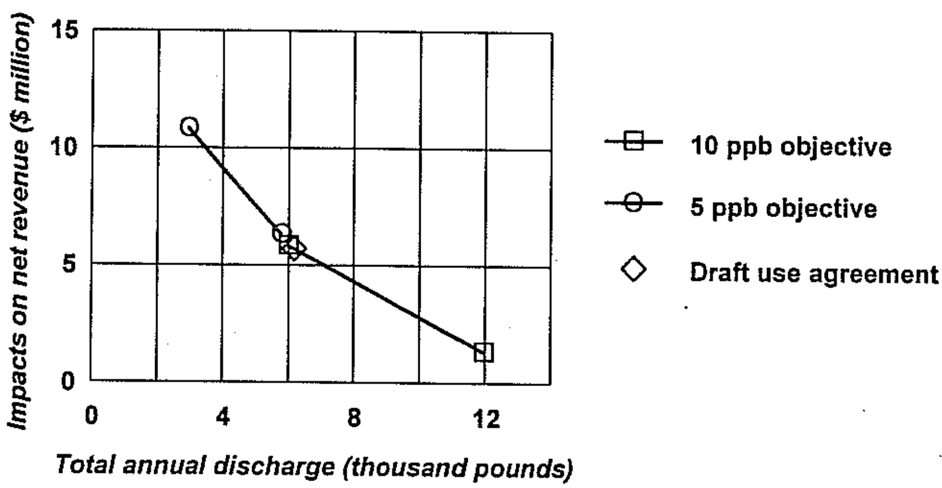
***Use of Farm Production Model.*** An optimizing model of agricultural production was used to estimate the effect of restrictions on discharges. The model assumes that growers respond to restrictions on selenium discharges by using drainage water for irrigation, changing crops, changing irrigation systems, and fallowing acreage. Growers select the combination of responses which maximizes their net revenue over the five-year study period. When drainage water is used for irrigation, salt accumulates in the soil, reducing yields. Impacts on revenues are low in the first year of the scenario, but steadily increase, reaching the values shown in the table in the fifth year. Losses in revenues are largely the result of falling yields and a shift in production away from higher-valued salt-sensitive crops.

The report presents impacts on gross revenues. Gross revenues are useful for comparison with recent production trends in the area, but do not indicate costs to growers. Impacts on net revenues were provided by the authors of the report and are shown in the table.

The cost per pound of removing selenium indicated by these results can be estimated from the variation of impacts on net revenues with total discharges. Although the impact of a given discharge limitation increases over time, impacts in the fifth year are a reasonable approximation of the average annual impact of a limitation. At normal discount rates, lower impacts in earlier years are roughly balanced by the higher impacts occurring in later years.

These results are shown in the graph below. The slope of the two line segments shows the incremental cost of reducing selenium discharges in the way indicated by the model. The cost per pound is $750 per pound when discharges exceed 6,000 pounds/year, rising to $1,600 per pound when discharges are between 3,000 and 6,000 pounds/year.

**Variation of Net Revenues with Selenium Discharges as Indicated by the Model Results**




***Limitations of Analysis.*** The analysis in the Grassland Drainers' Report has some important limitations. The units of analysis in the model are the four districts in the Grasslands area. Selenium loads are allocated among the districts in proportion to the drained acreage in each district. The model is run separately for each district, finding the combination of actions which maximizes net revenue subject to the selenium load constraint faced by each district.

Analyzing each district separately gives the least-cost solution only if the removal of a pound of selenium from drainage water has the same impact on net revenues in all districts. However, it is likely that the cost of removing selenium varies between districts. In this situation, the cost of meeting the overall load limitation can be reduced below that indicated by the model results if districts with lower unit costs were to remove more selenium, allowing districts with higher unit removal costs to remove less.

Similarly, the model results give the least-cost solution only if the cost of removing a pound of selenium is the same throughout each district. Some areas have lower removal costs than others. An improvement in irrigation practice which reduces deep percolation by a given amount will remove more selenium where drainage water has a high concentration of selenium. Intensive management, or fallowing, of acreage in high-selenium areas could reduce loading at a lower unit cost than those indicated in the report.

This is not mean that a least-cost load reduction would require a disproportionate share of costs to be borne by landowners in high-selenium areas. Load reduction could be managed by allocating the allowable selenium load between districts in any manner considered equitable and allowing landowners to trade their allocations.

***Regional Economic Impacts.*** The report also presents estimates of regional economic impacts of reducing selenium loads. Input-output multipliers are used to estimate the change in county gross output and employment occurring as growers and their employees reduce purchases from other businesses in the area.

These figures should be interpreted carefully. Impacts on total output in the county are an impact on transactions and do not measure income losses or costs imposed on businesses or individuals in the area. The indirect costs of reducing selenium loads would be better measured by applying an income multiplier to impacts on wages and farm proprietors' income.

For a number of reasons, the analysis overestimates the regional job impacts of load restrictions. First, multipliers are applied to an impact on agricultural output which is the combined result of reduced yields and a shift to lower-valued crops. However, a fall in output resulting from reduced yields will not affect the region's economy in the way implied by multipliers. One of the assumptions behind input-output analysis is that use of inputs changes in proportion to output. But if yields fall, use of labor and other inputs will not fall in proportion to output. Harvest costs and some chemical costs may be lower, but many production costs will remain the same. Consequently, the regional impacts of reduced yields will be lower than indicated by applying multipliers to impacts on output.

The analysis also neglects the regional impacts of improvements to irrigation systems. This response will have some offsetting positive impacts, since part of the expense of installing an improved irrigation system is a purchase from the local economy. Better irrigation management may also result in higher labor costs, which will also generate positive regional impacts.

The table below shows how the economic impacts of each response differs. Applying a multiplier to the overall impact on output will give misleading results.

**Economic Impacts of Responses to Limitations in Selenium Loads**

| Response | Direct Impacts | Indirect impacts |
|---|---|---|
| Retirement of acreage. Shift to lower valued crops. | Reduces gross output, net revenues, and purchases of inputs. | In the short run, jobs and incomes may fall by up to the extent indicated by Input-Output multipliers. Analysis should be done on a crop-by crop basis rather than applying multipliers to overall change in production. |
| Reduced yields | Reduces gross output and net income. Reduces some production costs. | Indirect impacts will be smaller than indicated by multipliers, use of labor and other input does not fall in proportion to output. |
| Improved irrigation systems | May increase gross output if yields increase. Reduces net income because production costs increase. | May have a positive regional impact because the higher costs of the improved irrigation system are a purchase form the local economy. |

Finally, input-output analysis assumes that trading patterns between industries are fixed and businesses have no ability to adapt to changing conditions by seeking new markets. Input-output multipliers give upper limits on the short-term economic impacts of a change in production. In practice, impacts will be smaller, since growth in other sectors of the economy will absorb the impacts. Since the impacts will occur over five years, some of the impacts occurring the earlier years will be absorbed before the impacts in later years occur. Consequently, the cumulative impact occurring in the fifth year will be smaller than indicated by applying multipliers to the direct impacts in the fifth year.

If you have any questions or would like to discuss this matter further, please call me at 653-0463.

State of California

# Memorandum

**To:** 1. Barbara L. Evoy, Chief
Office of Statewide Consistency

2. Dennis Westcot
RWQCB, Central Valley Region

**Date:** February 1, 1996

Adrian Griffin

Adrian Griffin, Senior Economist
Economics Unit, Office of Statewide Consistency

**From:** **STATE WATER RESOURCES CONTROL BOARD**
**901 P Street, Sacramento, California 95814**
**Mail Code G-8**

**Subject:** REVIEW OF COMMENTS ON PROPOSED RESTRICTIONS ON SELENIUM DISCHARGES

In response to your request, I have reviewed *Comments Regarding the Compliance Time Schedule for Regulating Agricultural Subsurface Drainage Discharges in the San Joaquin River Basin*, prepared by the San Luis and Delta-Mendota Water Authority, December 1995 (SLDMWA Report).

The costs given in the SLDMWA report are of limited use in assessing the economic impacts of the restrictions on selenium discharges proposed in the RWQCB staff report. The main reasons are first, that the SLDMWA Report examines scenarios which differ from those proposed in the staff report and second, that the SLDMWA Report does not demonstrate that the responses that it describes are the least-cost combination of actions which meets a particular discharge limitation.

***Scenarios Examined***

The RWQCB staff report proposes a plan based on a concentration-based performance goal and a 5ppb, 4-day average water quality objective. Load-based goals will be adopted only if the concentration goals are exceeded. However, the SLDMWA Report examines the following scenarios:



A. Load-based performance goal with the 5 ppb, 4-day average concentration standard.

B. Load-based performance goal without the 5 ppb, 4-day average concentration standard.

C. Concentration-based performance goal based on mean monthly concentrations.

The figures presented in the SLDMWA Report show that removing the load-based goal reduces costs substantially. However, because of the way in which the scenarios are constructed, the figures do not dirctly indicate the savings resulting from removing the load-based goal while leaving the 5 ppb, 4-day average concentration standard in place.

*Responses to Restrictions on Discharges*

The costs in scenarios A and B are the costs occurring as some drainage water is reused, plus the costs of treating part of the drainage water. However, there is no discussion on how the particular combination of recirculation and treatment was determined. The SLDMWA Report does not show that the costs presented are those of the least-cost combination of actions that will meet the limits on discharges.

The report also presents the regional economic impacts of reducing discharges of selenium. These estimates are subject to the same limitations as the estimates of costs of reducing discharges.

*Land Retirement*

The report discusses the regional economic impacts of land retirement. The report states that retiring 20 percent of the farmland in the Grasslands area would have greater economic impacts than reducing selenium discharges by reuse and treatment of drainage water.

This discussion misinterprets the role of land retirement in reducing selenium discharges. Land retirement is a possibility for acreage producing high loads of selenium. Land retirement may be part of a solution involving reuse of drainage water, improved irrigation management and drainage water treatment. An analysis on a field-by-field basis would be necessary to determine the combination of actions that would meet discharge restrictions at the lowest cost or with lowest impacts on the region's economy.

If you would like to discuss my comments further, please call me at 653-0463.

## APPENDIX 6

## RECOMMENDED FORMAT FOR COMMENT LETTERS

## RECOMMENDED FORMAT FOR COMMENT LETTERS

Comment letters to the Regional Board on staff recommendations serve two purposes: 1) to point out areas of agreement with staff recommendations; and 2) to suggest revisions to staff recommendations. Clear statements of both areas of agreement and suggested revisions will assist the Regional Board and staff in understanding the recommendations of the commenter. The California Environmental Quality Act requires staff to respond to those comments submitted by the public which suggest revisions to staff recommendations, as long as those comments concern the environment. Staff will respond to all comments received by 17 April 1996 which suggest revisions to the Basin Plan Amendment. In order to aid staff in identifying suggested revisions and to respond to the specific concerns of the commenter, the following format for comment letters is suggested:

### Format for Comments Suggesting Revisions

The suggested format is to number the comment, state in one sentence the topic upon which the comment is directed, provide a supporting argument, and make a recommendation. Supporting arguments which include citations will assist staff in considering the comment. Below is an example.

The Environmental Action Team (EAT) recommends the following revision to staff recommendations:

1. *Proposed Xenon objective on Slug Slough*

Staff has recommended a 0.001 ng/L Xenon objective to protect resident guppies in Slug Slough. The U.S. EPA Xenon criteria for protection of guppies in fresh waters is currently 0.0001 ng/L - an order of magnitude lower than the staff recommendation. The U.S. EPA criteria is supported by several studies in peer reviewed journals (e.g. Smith and Jones; J. Env. Qual. (1994); Johnson; J. Env. Qual. (1995)). Staff arguments that the cost of analyzing for Xenon in water below 0.001 ng/L is prohibitive does not support the adoption of a water quality objective that is not protective of beneficial uses. More cost effective analytical procedures may be developed in response to the need for more intensive Xenon analysis. **EAT, therefore, strongly recommends the adoption of a 0.0001 ng/L Xenon objective to fully protect guppies in Slug Slough.**

### Format for Comments Supporting Staff Recommendations

If the commenter concurs with a staff recommendation, a statement to that effect will assist the Regional Board in determining what action, if any, to take on the staff recommendation. In general, no supporting discussion need be presented, unless the commenter feels that the staff recommendation could be further enhanced or clarified. Below is an example.

2. *Proposed Neon objective for Slug Slough*

**EAT strongly supports the adoption of the 0.05 pg/L Neon objective proposed by staff for Slug Slough.** In addition to arguments presented by staff, it should be pointed out that Harrison's recent work on goldfish (Harrison, et al, 1996) confirms the appropriateness of the proposed objective for the protection of fresh water aquatic life.